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A MANUAL
OF
PRACTICAL ANATOMY

HUGHES' ANATOMY

PART I.

THE UPPER AND LOWER EXTREMITIES

PART II.

THE ABDOMEN AND THORAX

(In the press)

PART III.

THE HEAD, NECK, AND CENTRAL NERVOUS SYSTEM

(In the press)

A MANUAL
OF
PRACTICAL ANATOMY

BY THE LATE
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IN THREE PARTS

PART I.

THE UPPER AND LOWER EXTREMITIES

Illustrated by 38 Coloured Plates, and 116 Figures in the Text

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TO
HIS FORMER PUPILS
OF
EDINBURGH, CARDIFF, AND LONDON
BY ALL OF WHOM
HE WAS GREATLY BELOVED

THE

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PREFACE

PROFESSOR ALFRED W. HUGHES, the author of this work, died in the service of his country, still young, and widely regretted. It was he mainly who, in the early spring months of 1900, when the medical resources of our army in the field were taxed to the uttermost, turned the tide of his countrymen's enthusiasm into that most beneficent proof of patriotism—the Welsh Hospital for South Africa. On June 15, the disastrous epidemic of typhoid being then at its height, news of a grave crisis in the affairs of the Welsh Hospital, owing to deaths and sickness among the staff, reached the Executive Committee at home; Professor Hughes at once volunteered, and in twenty-four hours was on his way to South Africa. In his charge the Hospital performed services at Springfontein and Pretoria which received the commendations of the Commander-in-Chief, Lord Roberts, and the Principal Medical Officer of the Army. On October 19, having accomplished his mission, he returned to England, stricken with typhoid contracted while on duty, and died on November 3, 1900, aged 39.

Probably no man in this country was better qualified than Professor Hughes to produce a standard work on

Practical Anatomy. He was reared and matured in the ever-famous Edinburgh School of Anatomy; to him fell the fruitful experience of equipping and developing the newly-founded chair of Anatomy in the University College of South Wales; later, at King's College, his work lay in the centre of the great London Schools, where the teaching of anatomy finds its most practical expression. He could bring to bear, too, experience gained in the actual pursuit of his profession, without which no teacher can place the thousands of facts that lie within the bounds of Practical Anatomy in their just perspective. Lastly, he possessed those rarer gifts—the key to his students' hearts and an ever-ready ear for their difficulties; and by these he learned how to adjust and make his methods more and more effective. This work is evidence that he profited by these opportunities to the fullest extent.

When, after his death, the manuscript of this book was entrusted to the present writer, much clerical work still remained to be done to make it a complete guide to the dissection of the human body. The outline of the whole work was laid down; the author's intentions were clearly indicated. He had proceeded as a careful workman may with a piece of mosaic work, laying down part after part, but leaving blanks—often with a side-note for future self-guidance—to be filled in when the main outlines were finished. Of the three parts in which this work is issued, Part I., which deals with the Anatomy of the Extremities, was practically complete; Part II., which includes the Anatomy of the Abdomen and Thorax, was approaching completion; while Part III., dealing with the Head, Neck,

and Central Nervous System, was well begun. But in every case where a blank has been filled in, the editor has followed the spirit of the author and dealt with each subject according to its relative importance from a medical or surgical point of view ; new procedures in surgery or medicine had to be followed by alterations in the routine of dissection and method of description.

The introduction of the formalin method of preserving subjects has necessarily entailed a considerable modification in the ordinary routine of dissection, and, so far as the writer is aware, this is the first text-book issued which meets the new requirements. Advances in Surgery and Medicine have also led to modifications of the usual manner in which parts are undertaken.

It was the intention of Professor Hughes to make the illustrations a leading feature of this work, and he employed Mr. Prendergast Parker to prepare under his supervision a series of coloured drawings from the dissections in the Alfred Hughes Collection at King's College. Of the thirty-eight coloured plates which appear in Part I., twenty-four are reproduced from Mr. Parker's drawings, the remaining fourteen being coloured osteological plates, borrowed from Holden's 'Osteology,' which must prove of the utmost value to the student in his laborious task of tracing the origins and insertions of muscles. Of the hundred and sixteen figures in the text of Part I., seven are borrowed from Morris's 'Treatise on Anatomy, seventy-eight have been obtained, with due acknowledgments, from other works issued by Messrs. J. & A. Churchill, while thirty-one have been prepared for Part I. by the

writer. For thirteen of these he is indebted to his former pupil, Mr. HERMAN BALEAN.

By issuing this work in three parts a boon is conferred on the student. The bulk of many text-books now in use renders them difficult to handle and place in the course of dissection. The parts are arranged in the order in which the student usually undertakes the dissection of the human body.

The writer is much indebted to Mr. J. H. WATSON for suggestions and corrections in the proofs of this Part.

ARTHUR KEITH.

LONDON HOSPITAL MEDICAL COLLEGE :

September 3, 1901.

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MANUAL OF PRACTICAL ANATOMY

PART I

DISSECTION OF THE UPPER EXTREMITY

DISSECTION I

THE DORSAL REGION OF THE UPPER EXTREMITY

POSITION OF THE SUBJECT.—The student will find the body lying face downwards on the dissecting table. Blocks have been placed under the breast and loins to raise up the regions of the shoulder and hips. The body has been drawn towards one end of the table, so that the lower extremities may hang downwards. The dissector of the upper extremity, probably now making his first essay in practical human anatomy, will find that the dissectors of the head and neck, who now commence to uncover the structures on the dorsal aspect of their part, can be of great service to him, and he should seek with them a friendly understanding which will help him in the numerous little difficulties which he will soon encounter. Many structures lie partly in their dissection and partly in his, and such must be dissected in common.

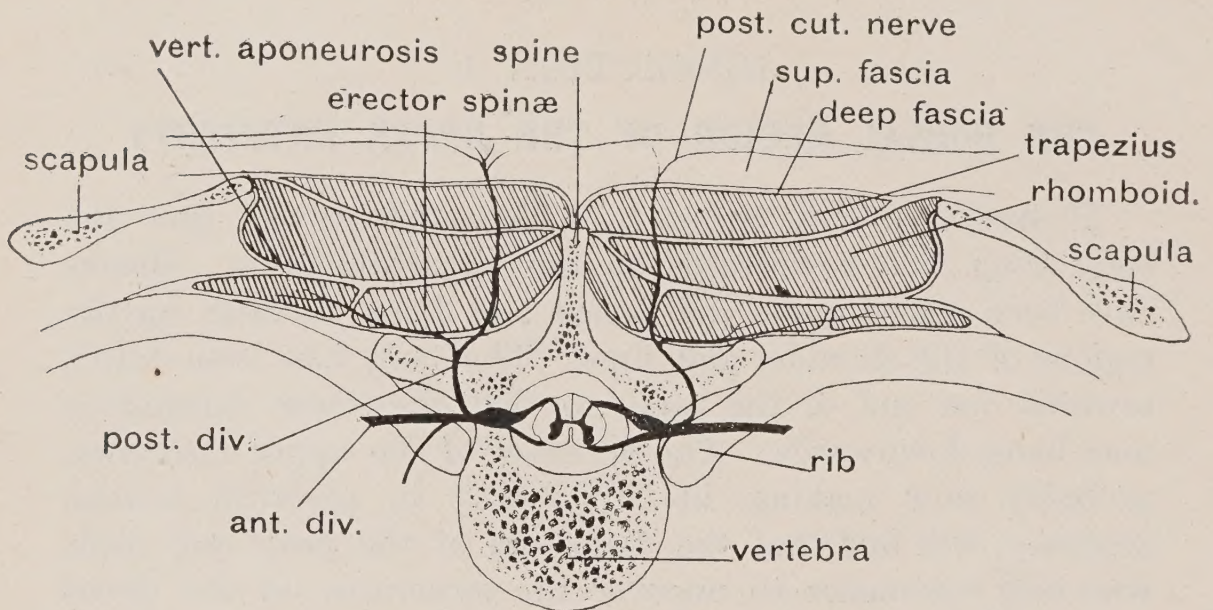
SURFACE MARKINGS.—The student should now seek out and recognise the spine of the seventh cervical vertebra. It is the separation mark between his part and that of the dissectors of the head and neck. If he is not already familiar with the spinal column, he should examine the skeleton in the dissecting-room, and he will see that the seventh cervical spine is the first one to point prominently. Commencing on his part with the seventh spine, the student will be probably able to make out the twelve dorsal and five lumbar

2 THE DORSAL REGION OF THE UPPER EXTREMITY

spines. The spines are the guides to the deep structures of the back. They are really levers projecting backwards from the vertebræ (fig. 1) and give insertion and origin to muscles. From each side of their tips, muscles which the student has to expose presently take their origin, and pass to the shoulder.

The spine of the scapula can also be felt from its base at the vertebral border of the bone to its termination in the acromion process over the shoulder. The scapula rests on the posterior and outer aspects of the ribs, from the second to the seventh. The base of the spine of the scapula, he should observe, is opposite the third dorsal spine.

FIG. 1.—SHOWING THE ORIGIN OF MUSCLES FOR THE UPPER EXTREMITY FROM THE SPINE OF A DORSAL VERTEBRA, AND THE DIVISION OF A SPINAL NERVE INTO ANTERIOR AND POSTERIOR PRIMARY DIVISIONS. (*H. Bailean.*)

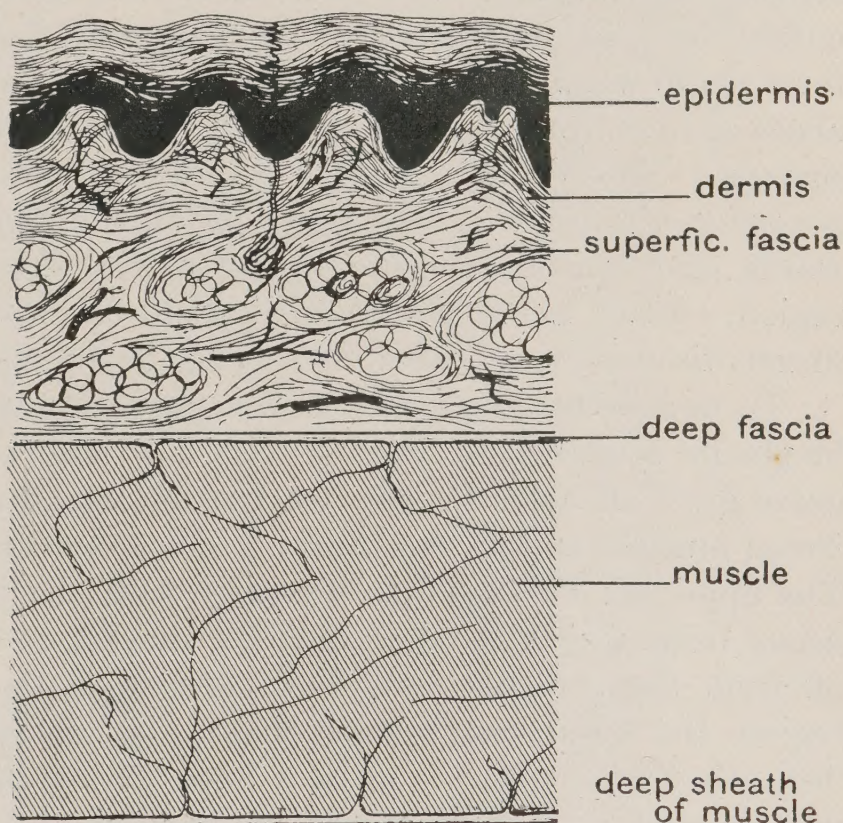


REFLECTION OF THE SKIN.—He will find that the dissectors of the head and neck have already made a vertical incision along the middle line of the body from the external occipital protuberance to the tip of the coccyx, and a transverse one from shoulder to shoulder over the seventh cervical spine. The dissector of the lower extremity has also made a transverse incision along the crest of the ilium; the skin between these two transverse incisions has to be reflected by the dissector of the upper extremity in order that he may see the muscles which, arising from the spines of the vertebræ, pass outwards to act on the shoulder. This great area of skin he must raise in two pieces; an oblique incision from the first lumbar spine to the shoulder a little below the acromion pro-

cess will divide the area into an upper and a lower flap. The upper flap is raised first. Commence at its inner border and reflect it outwards. After commencing to raise the flap, the student should read the following paragraph and examine figure 2.

THE SUPERFICIAL FASCIA.—The student may reflect too much or too little. He may raise only the superficial layer of skin (fig. 2), or he may raise with it the whole of the superficial fascia, the tissue which lies beneath the skin and binds

FIG. 2.—A SECTION SHOWING THE SKIN, SUPERFICIAL FASCIA, DEEP FASCIA, AND MUSCLE. (H. Bailean.) (Diagrammatic.)



it to the deeper structures. Were it not for the superficial fascia the skin could be stripped from the body as a glove from the hand. If the superficial fascia is reflected with the skin, then all the vessels and nerves which ramify in it, as they pass to furnish the skin with nourishment and sensation, will be removed unseen. The beginner may easily let his knife pass deeper and deeper until he reflects with the skin, not only the superficial, but also the *deep fascia*. The demonstrator or the dissectors of the head and neck will keep the beginner right as to the depth at which the skin should be reflected.

4 THE DORSAL REGION OF THE UPPER EXTREMITY

The superficial fascia, then, is the areolar tissue beneath the skin. It serves three main purposes : (1) to bind the skin to the underlying layers ; (2) to conduct vessels and nerves to the skin ; (3) to act as a storehouse of fat.

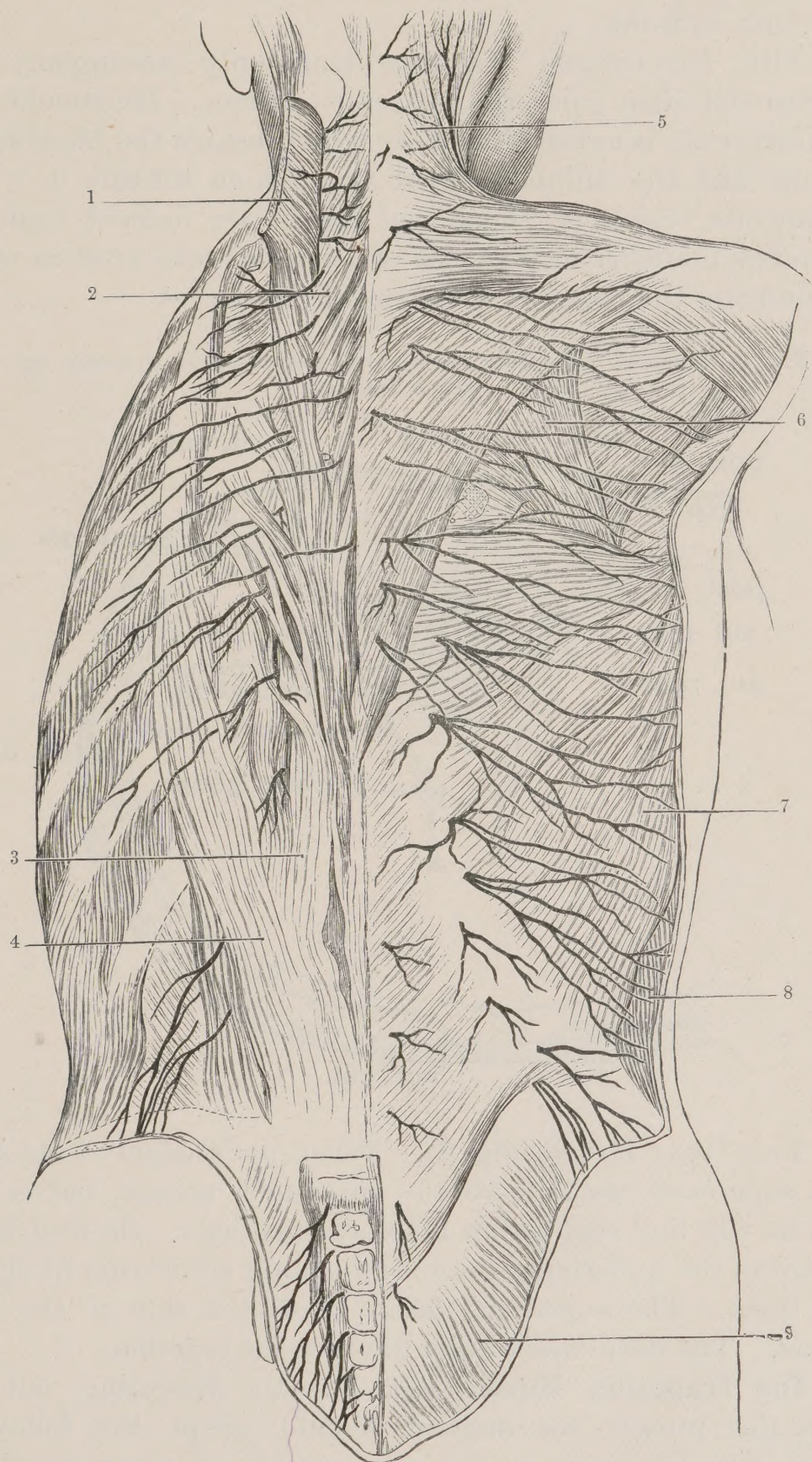
The fat is formed in cells of the fascia. The subcutaneous tissue (superficial fascia) of the back is thick and tough.

THE SUPERFICIAL NERVES.—The student is to seek for these as they ramify in the superficial fascia before entering the skin. At first he may doubt if the structure which he has found is a nerve or merely a strand of fibrous tissue. The fibres of which a nerve is composed give it a characteristic striated appearance. The student should search in the subcutaneous tissue opposite the spine of the third dorsal vertebra for a nerve which pierces the deep fascia and turns outwards about an inch from the spine (fig. 3). It ends in the skin over the scapula. This is the largest of a series of fourteen or fifteen *posterior cutaneous nerves* which he should find passing outwards, each opposite a spine, to end in the skin of the dorsal region. Each nerve must be followed to its termination, the fibrous tissue which surrounds it being neatly cleaned away.

To understand the origin of the posterior cutaneous nerves he should consult figs. 1 and 4. He will observe that a spinal nerve gives off a *small posterior* division which passes into the dorsal muscles and divides into an *internal* and *external branch*. The upper six dorsal spinal nerves give off the *posterior cutaneous* from the internal branches ; the six lower give them off from the *external* branches. Hence in the lower dorsal region the cutaneous nerves should be looked for at some distance (two or three inches) from the spines. Only the first, second, and third of the lumbar spinal nerves give off posterior cutaneous branches ; these pass into the gluteal region, and are found by the dissector of the lower extremity.

LATERAL CUTANEOUS NERVES.—As the dorsal spinal nerves pass forwards between the ribs, each (except the first) gives off, near the lateral line of the body, a lateral cutaneous branch (fig. 4). The student should encounter the posterior branches of the lateral cutaneous nerves near the outer part of the area from which he has reflected the skin. Each spinal nerve at its termination gives off an *anterior cutaneous* branch, which will be seen when the anterior aspect of the body is dissected. The student will then see that each spinal nerve supplies, through its posterior

FIG. 3.—THE CUTANEOUS NERVES OF THE BACK. (*Henle.*)



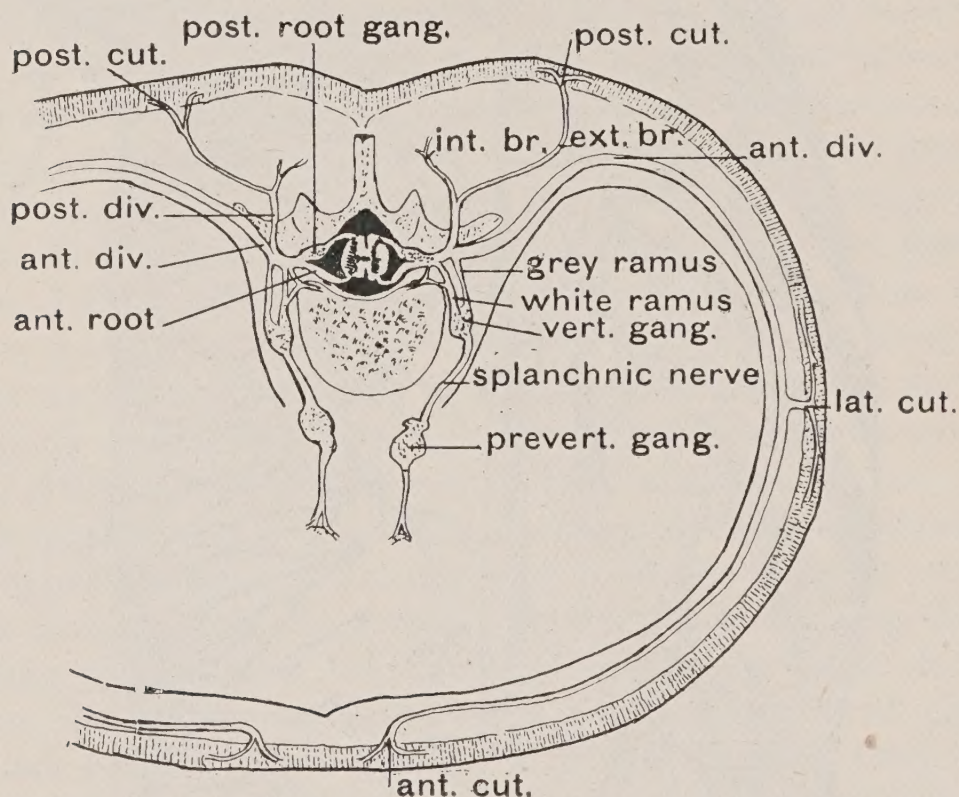
1. Semi-spinalis. 2. Multifidus spinæ. 3. Longissimus dorsi. 4. Ilio-costalis. 5. Trapezius.
6. Rhomboideus major. 7. Latissimus dorsi. 8. External oblique. 9. Gluteus maximus.

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lateral and anterior cutaneous branches, a circular belt of skin, which extends from the spines behind to the ventral line of the body in front.

THE CUTANEOUS VESSELS commonly accompany the nerves and often guide the dissector to them. He should note the difference between the artery which brings the blood to the tissues and the thinner-walled vein which returns it. The cutaneous vessels of the dorsal region are derived from the posterior branches or divisions of the intercostal arteries which accompany the posterior divisions of the nerves.

FIG. 4.—SHOWING THE ORIGIN AND RAMIFICATION OF A TYPICAL SPINAL NERVE (SIXTH DORSAL).

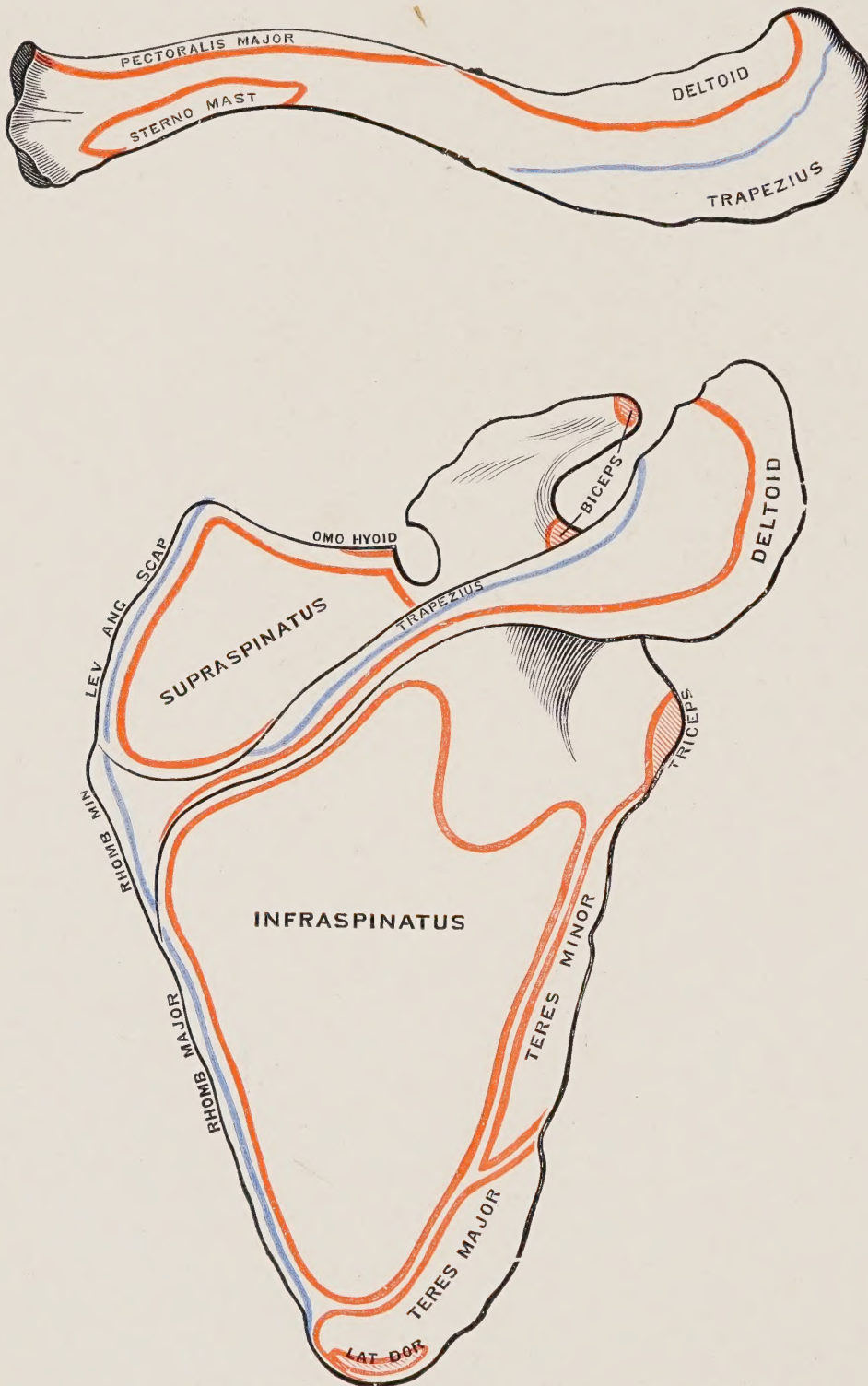


THE DEEP FASCIA (fig. 2).—When the student clears away the superficial fascia with the contained vessels, nerves and fat, he will find that a thin membranous layer—the deep fascia—covers the underlying muscles, forming a covering or sheath for them. The superficial fascia binds the skin to the deep fascia. The deep fascia knits the muscles together.

The Trapezius Muscle (fig. 5).—In dissecting out the trapezius muscle the student should adopt the following method, and apply it in the examination of every muscle of the body:—(1) Remove the connective tissue from the

PLATE I.

SHOWING THE MUSCULAR ATTACHMENTS ON THE DORSAL ASPECT OF THE SCAPULA AND UPPER ASPECT OF THE CLAVICLE. (*After Holden.*)



The points of origin are marked red ; those of insertion are blue.

points of origin. (2) Clear the tissue away from the insertion. (3) Make out the borders of the muscle. (4) Remove the deep fascia or sheath from the muscle. In doing this he should commence at one border and ply his knife *along* the line of the fibres from their commencement to their termination, and thus remove the fascia as a continuous sheet from one border of the muscle to the other. (5) Examine the nerve supply. (6) Examine the blood supply. (7) Study the action. (8) Note the structures that lie beneath the muscle. Not one of these points should be omitted; he should seek to become as familiar with the details of the human body as with the corners of his own home.

ORIGIN OF TRAPEZIUS.—(1) The inner third of the superior curved line of the occipital bone; (2) the ligamentum nuchæ in the median line of the neck (these two parts of origin are made out by the dissectors of the head and neck); (3) the tips of the spines and interspinous ligament from the seventh cervical to the tenth or twelfth dorsal. The middle part of the muscle has a membranous origin.

INSERTION.—(1) The upper fibres pass in the neck to the posterior border of the outer third of the clavicle; (2) to the inner border of the acromion process; (3) to the upper border of the spine of the scapula; (4) the lower fibres end in a tendinous expansion which is inserted to the tuberosity at the root of the spine. The fibres converge as they pass to their insertion. (See Plate I.¹)

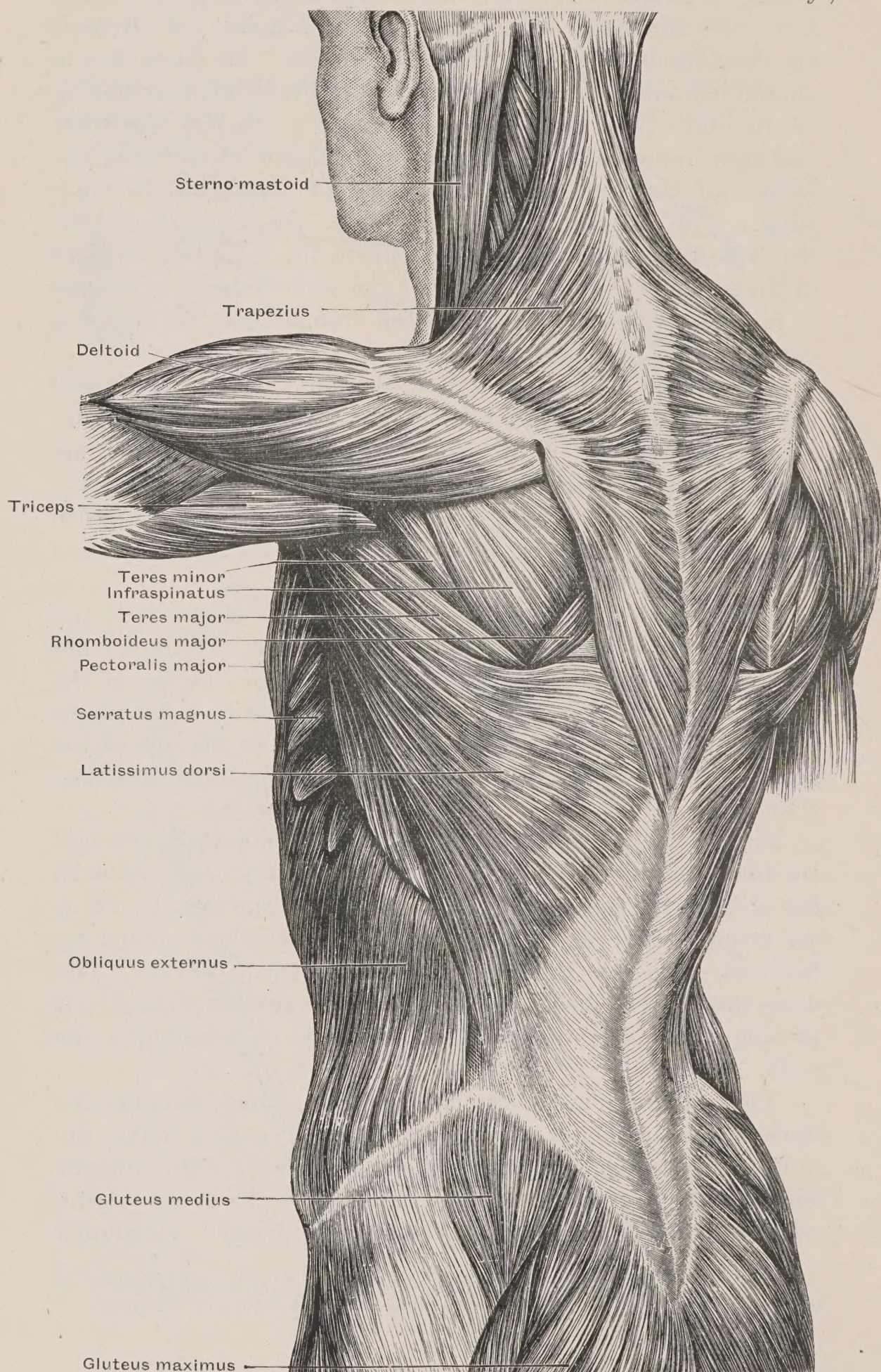
NERVE SUPPLY.—When a vertical incision is made through the fibres, a little internal to the posterior (vertebral) border of the scapula, the nerve will be found beneath the muscle. It is the terminal part of the spinal accessory, which is joined by fasciculi from the third and fourth cervical nerves. The dissectors of the head and neck will point the nerves out passing obliquely downwards in the posterior triangle of the neck.

THE SUPERFICIAL CERVICAL ARTERY, which supplies the muscle, will be found near the nerve. It passes under the muscle from the posterior triangle of the neck. The student should make it a habit to completely remove the areolar tissue which surrounds and forms a bed for the artery. He should

¹ The work of the student in making out the points of origin and insertion of muscles is facilitated by reference to the plates on which these are indicated.

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FIG. 5.—FIRST LAYER OF MUSCLES OF THE BACK. (*From Morris's 'Anatomy.'*)



follow the artery from its origin to its termination. Dissection, he will find, is a matter of removing the areolar tissue, fascia, and fat in which the structures of the human body are imbedded, and by which they are bound together.

ACTION.—The student will see from its attachments that the trapezius can pull the shoulder towards the spine as in standing to attention. It elevates the shoulder, an action best seen in raising the outstretched arm to the head.

THE POST-ANGULAR HIATUS is a triangular interval behind the angle of the scapula in which an intercostal space appears. The lower border of the trapezius bounds it above, the upper border of the latissimus dorsi below, and the rhomboid and angle of the scapula in front (fig. 5).

Latissimus Dorsi (fig. 5).—This is a thin, very extensive sheet, and difficult to clean. When the body is turned, its terminal part will be seen entering into the formation of the posterior wall of the axilla. To examine its upper part, the trapezius has to be detached at its origin from the spines and thrown outwards.

ORIGIN (fig. 5).—(1) From the lower six dorsal spines; (2) from all the lumbar spines, through the posterior layer of the lumbar aponeurosis; (3) from the posterior third of the crest of the ilium, the anterior part arising directly by muscle; (4) by digitations from the lower three or four ribs, the fibres interdigitating with fibres of the external oblique muscle of the abdomen; (5) occasionally by a muscular slip from the lower angle of the scapula.

INSERTION.—By a flat tendon to the floor of the bicipital groove of the humerus. Its insertion will be seen at a later stage.

Its origin should now be detached. In reflecting the origin of this muscle, the student should seek the aid of the dissectors of the abdomen, as the muscle really forms a constituent of the abdominal wall below.

NERVE SUPPLY.—From the long subscapular nerve. It will be found beneath the muscle at the angle of the scapula when the latissimus dorsi is reflected forwards.

The artery which principally supplies the muscle is the subscapular. It accompanies the nerve.

ACTION.—The characteristic action of the muscle is seen in crossing the arms behind the back. It retracts the arm and

shoulder, and at the same time rotates the arm inwards. It assists in lifting the body if the arms are fixed overhead.

The **Rhomboideus Major** (fig. 5A) lies beneath the trapezius. Only the occipital fibres of that muscle should now remain unreflected.

ORIGIN.—From the spines and interspinous ligaments of the upper four or five dorsal vertebræ.

INSERTION.—To the vertebral border of the scapula, from the root of the spine to the lower angle. An examination will show a fibrous arch on the border of the scapula, stretching from the upper to the lower point of insertion. Many of the fibres end on the arch.

The **Rhomboideus Minor** is a detached band of muscle at the upper border of the rhomboideus major. It springs from the spine of the seventh cervical vertebra, and from the lower part of the ligamentum nuchæ. It ends in the vertebral border of the scapula, opposite the root of the spine.

ACTION.—The Rhomboids draw the scapula backwards and upwards, as in shrugging the shoulders. They also rotate the shoulder, so as to depress its point, as when the arm is passed behind the back.

To see the nerve and blood supply of these two muscles, they should be detached from the spines and thrown outwards.

The **Nerve to the Rhomboids** will be found beneath the muscles. It passes downwards about an inch behind the posterior border of the scapula. The dissector of the neck, in whose part the nerve arises, will point it out.

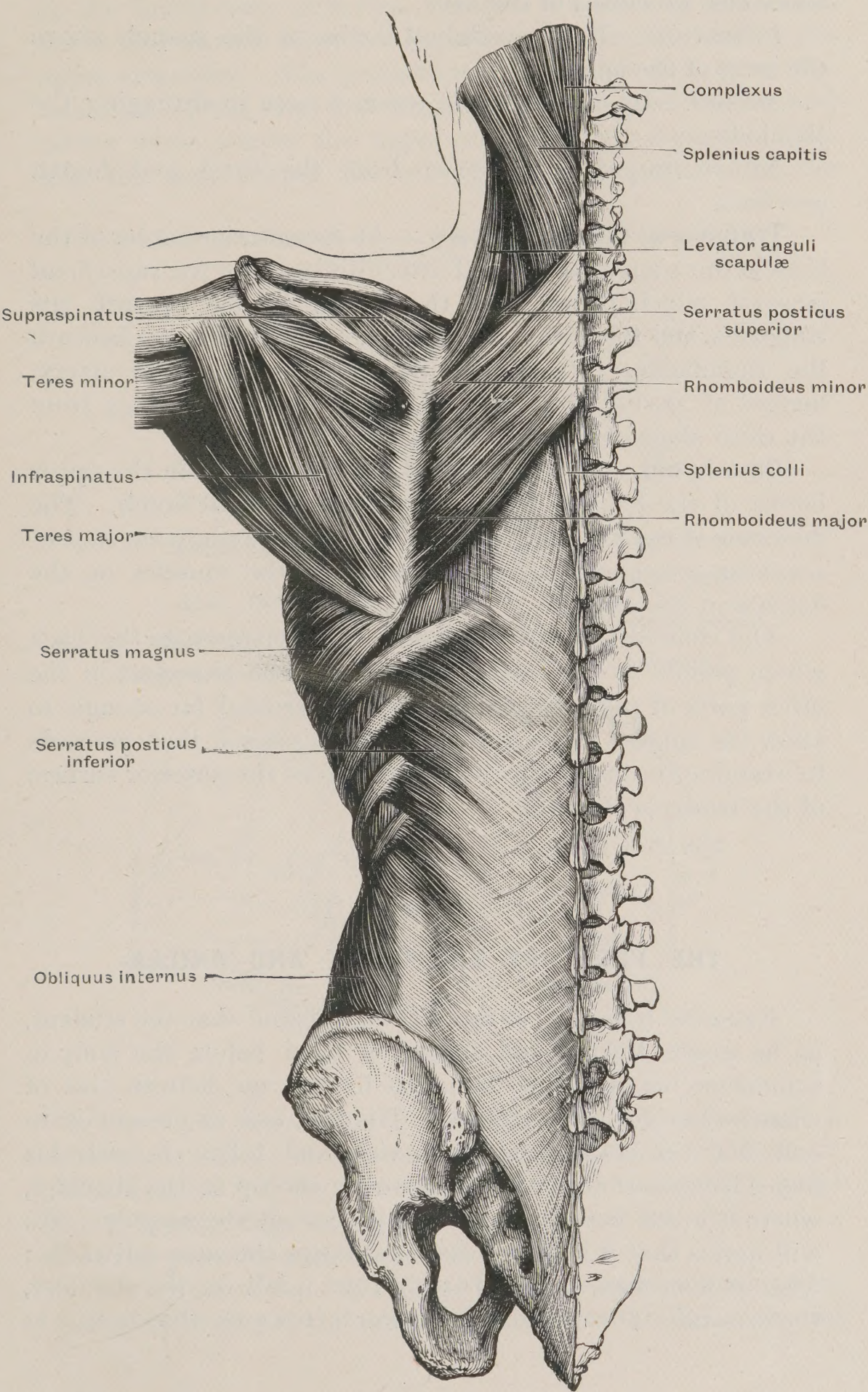
The **Posterior Scapular Artery** must be sought for along the posterior border of the scapula, beneath the insertion of the rhomboid muscles. The artery arises in the neck, and will be shown by the dissector of that part. It sends branches to the muscles on both deep and superficial aspects of the scapula, to the scapula itself, to the rhomboids and trapezius.

Beneath the rhomboids lie the ribs and muscles of the spine; with these the dissector of the upper limb has nothing to do. He has now examined the four muscles which act on the upper extremity from a fixed base on the spines.

Levator Anguli Scapulæ (fig. 5A).—Although this muscle acts on the shoulder and should certainly be seen by the dissector of the upper extremity, it is really situated in the neck and is dissected along with that part.

THE RHOMBOIDEI AND LEVATOR ANGULI SCAPULÆ 11

FIG. 5A.—THE LEVATOR ANGULI SCAPULÆ AND RHOMBOIDEI. (*From Morris's 'Anatomy.'*)



ORIGIN.—From the posterior tubercles of the upper five transverse processes of the neck.

INSERTION.—To the vertebral border of the scapula above the level of the spine.

ACTION.—Its characteristic action is seen in shrugging the shoulders.

NERVE SUPPLY.—A nerve from the third and fourth cervicals.

Transverse Cervical Artery.—At the anterior border of the muscle the transverse cervical artery divides into the *superficial cervical*, which passes over the levator to end beneath the trapezius, and the *posterior scapular*, which terminates beneath the rhomboids. Frequently the posterior scapular artery, instead of arising from the transverse cervical, springs from the third stage of the subclavian.

Omo-hyoid.—This small band-like muscle ends in the upper border of the scapula, behind the supra-scapular notch. The dissector of the neck will point it out, and also show the *supra-scapular artery* and *nerve* which end in the muscles on the dorsum of the scapula.

The student has now examined the structures in the back which pertain to the upper extremity. The dissectors in the other parts of the body should have progressed far enough to allow the subject to be turned. The dissector then proceeds to examine the structures which pass from the anterior surface of the trunk to the arm.

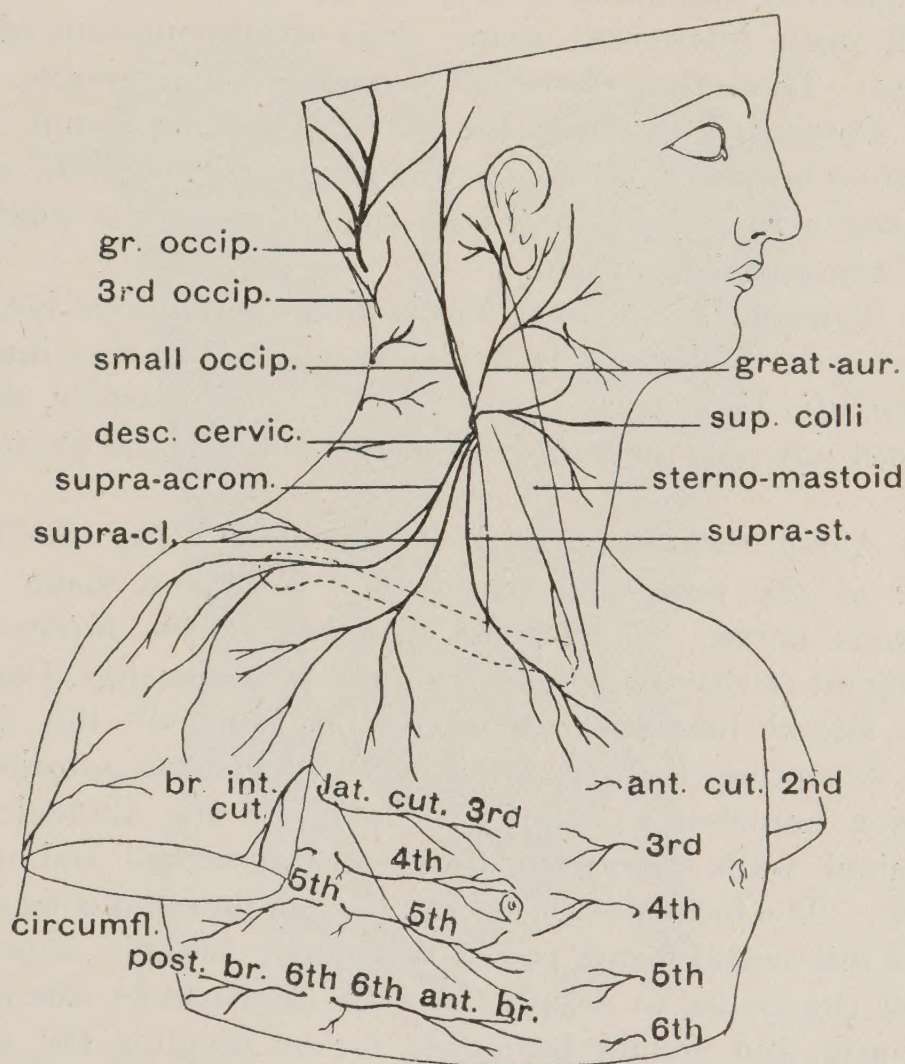
DISSECTION II

THE FRONT OF THE CHEST AND AXILLA

EXAMINE THE CLAVICLE.—It is probable that the student, as he stands forceps and scalpel in hand before the body to commence his first dissection, has formed no definite idea of what he has got to do and see. His first task at present is to seek out the collar-bone or clavicle and follow it with his finger from sternum or breast-bone to the tip of the shoulder, where it meets with the acromion process of the scapula. He will notice that it acts as a stay and keeps the arm outwards; when it is broken, as may happen from a fall on the shoulder, the arm falls downwards and inwards towards the chest. It

also acts as a basis for the origin of muscles to the arm. So do the breast-bone and ribs. Hence the front of the chest below the clavicle must be examined by the dissector of the upper extremity. The parts above the clavicle belong to the dissectors of the head and neck, but as the great vessels and nerves which supply the upper extremity pass from the neck into the arm behind the clavicle, it is important for the

FIG. 6.—INDICATING THE POSITION OF THE SUPERFICIAL NERVES AND VESSELS OF THE PECTORAL REGION.



beginner also to examine these structures, which he may do afterwards with the assistance of the dissectors of the neck. Meantime he may seek their advice as to the manner in which the following flaps of skin should be raised and reflected, so that the parts beneath may be examined.

SKIN INCISIONS.—The skin in this region should be reflected by means of the following incisions: (1) From the top

of the sternum down to the ensiform cartilage; (2) Along the clavicle from the sternum to the acromion process; (3) From the ensiform cartilage to the anterior fold of the axilla; (4) Another from the ensiform cartilage transversely outwards to the side of the chest. The nipple should be avoided and left *in situ*.

SUPERFICIAL VESSELS AND NERVES (fig. 6).—Now dissect in the superficial fascia:

(1) *Anterior cutaneous branches* of the intercostal nerves, which are accompanied by the small (2) *perforating branches* of the internal mammary artery, and are found in the anterior part of each intercostal space close to the margin of the sternum. There they pierce the pectoralis major muscle.

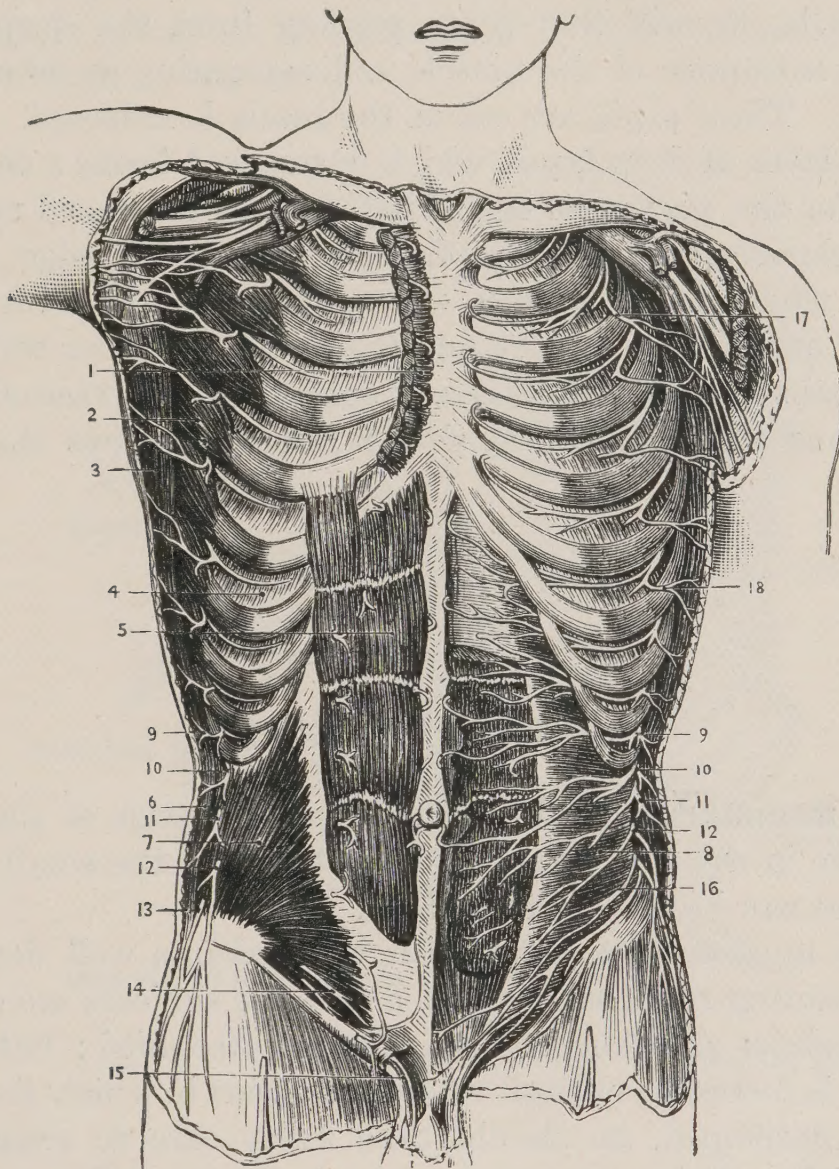
(3) Passing down over the clavicle will be found some *descending branches* of the cervical plexus, viz. *sternal*, *clavicular*, and *acromial*, together with some fibres of the platysma myoides superficial to them.

(4) Towards the shoulder will be found an interval between the Pectoralis Major and Deltoid muscles, and in this interval the *Cephalic Vein*, with a small accompanying artery, should be traced upwards until they disappear beneath the Pectoralis Major.

(5) Along the lateral wall of the chest, below the lower border of the pectoralis major, will be found some more cutaneous nerves, viz. *lateral branches of the intercostals*, dividing into two branches, anterior and posterior (figs. 4 and 7). These lateral branches are given off from all the dorsal nerves excepting the first, and they all divide into anterior and posterior branches to supply the skin of the thoracic and abdominal walls, excepting those of the second and of the twelfth. The former of these, viz. the lateral cutaneous of the second intercostal nerve, passes as a single branch across the floor of the axillæ, to supply the skin of the inner side of the upper arm, and should be looked for on dividing the strong axillary fascia lying towards the posterior part of the floor. Usually a second intercosto-humeral nerve is derived from the third intercostal nerve; this also passes downwards on the floor and posterior wall of the axilla to the inner side of the arm. The other exception, viz. the lateral cutaneous branch of the last dorsal, will be seen in another dissection. It passes as a single branch over the crest of the ilium, and will be found to supply a portion of the skin in the gluteal region.

STRUCTURES AT THE OUTER BORDER OF THE PECTORALIS MAJOR.—Just under the lower border of the pectoralis major some branches of (1) the *long thoracic artery* are to be found, along with which may be seen (2) some *lymphatic glands* which

FIG. 7.—SHOWING THE LATERAL CUTANEOUS BRANCHES OF THE INTERCOSTAL NERVES.
(Hirschfeld and Leveillé.)



1. Pectoralis major (cut). 2. Serratus magnus. 3. Latissimus dorsi. 4. Intercostal muscles.
5. Rectus abdominis. 6. Section of obliquus externus. 7. Obliquus internus. 8. Transversalis abdominis.
- 9, 9. Ninth dorsal nerve. 10, 10. Tenth dorsal nerve. 11, 11. Eleventh dorsal nerve.
- 12, 12. Twelfth dorsal nerve. 13. Iliac branch of ilio-hypogastric. 14. Hypogastric branch of ilio-hypogastric.
15. Inguinal branch of ilio-inguinal. 16. Ilio-hypogastric and ilio-inguinal nerves.
17. Intercosto-humeral nerve. 18. Lateral cutaneous branch of intercostal nerve.

receive the lymph from the mammary region and are frequently enlarged in some forms of mammary tumours (fig. 8).

THE DEEP PECTORAL FASCIA.—The superficial structures should now be removed from the surface of the pectoralis major.

If the subject is a female, the mammary gland must be examined, for it is entirely situated in the superficial fascia.

The deep pectoral fascia forms a thin membranous sheath for the pectoralis major muscle (fig. 2). The thin lax fibres of the superficial fascia bind it and the skin loosely together. When the student starts to reflect the deep fascia from the muscle by running his knife along, never across, the fibres of the muscle, he will find septa passing from the deep fascia into the substance of the muscle and separating its fibres into bundles. These septa are cut as the fascia is reflected.

The layer of deep fascia which covers and forms a complete sheath for the pectoralis major muscle may be traced upwards to the clavicle and downwards over the lower edge of the muscle, where it can be seen sweeping across the floor of the axilla or armpit to reach the muscles on the posterior wall, with the sheaths of which it becomes continuous. Externally it is continuous with the fascial sheath which envelops the upper arm.

DISSECTION III

THE MAMMARY GLAND

The Mammary Gland.—In the male a vestige of glandular substance in the subcutaneous tissue beneath the small nipple is all that can be seen of this gland.

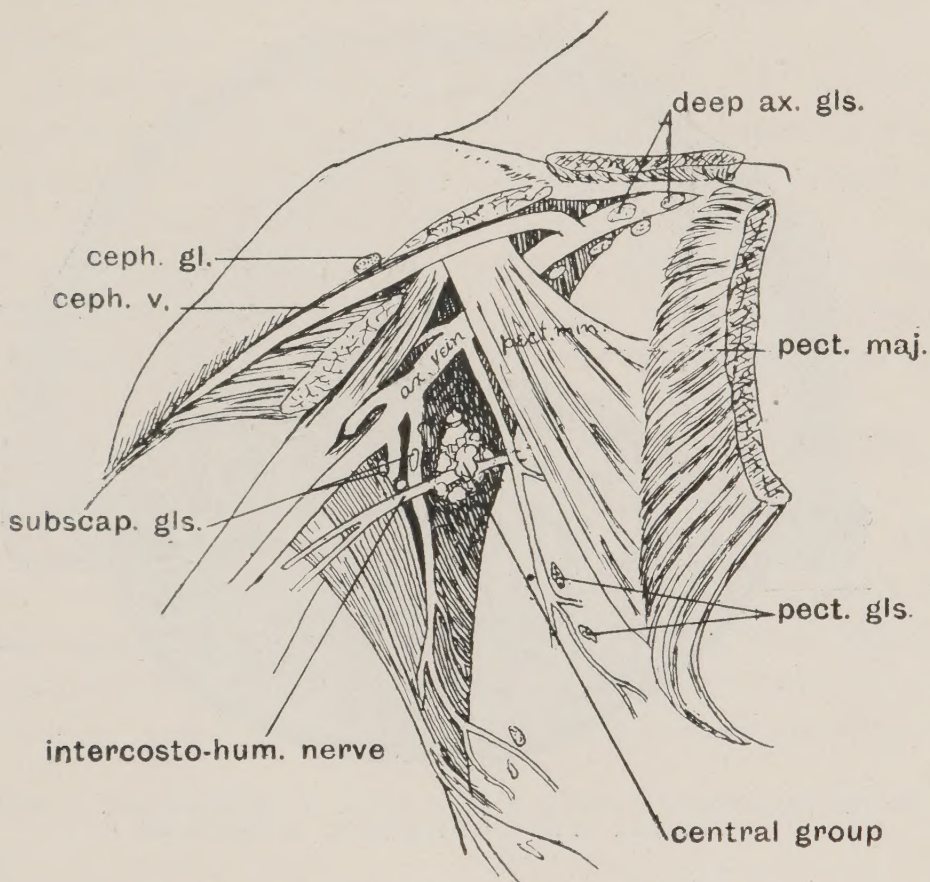
It is uncommon to meet with the mamma well developed in a dissecting-room subject; as a rule the subjects are old and the glandular substance of the mamma atrophied; but if the student is fortunate enough to dissect a part in which the gland is well developed, he should take every care to examine it thoroughly. It is a frequent seat of disease. His attention should be directed to the following points:—

1st. ITS EXTENT.—Internally it reaches the side of the sternum; externally it will be felt to be prolonged beyond the outer border of the pectoralis major into the axilla, by a part sometimes known as the axillary lobe; above it reaches to the second rib, below to the sixth. The nipple is situated over the fourth intercostal space.

2nd. ITS RELATIONSHIP.—The student should commence

at its inner border and raise it outwards, until the axilla is reached. He will observe that it lies in the superficial fascia and is bound loosely by areolar tissue to the sheath (deep fascia) of the pectoralis major. Slight processes of the gland, however, may lie in the deep fascia over the muscle, and into this fascia lymphatics from the gland pass; hence the necessity of removing this layer of fascia if the surgeon would make certain of completely removing the gland. The axillary lobe ends in the fibrous tissue of the axilla.

FIG. 8.—SHOWING THE POSITION OF THE AXILLARY LYMPHATIC GLANDS.
(Diagrammatic.) (After Leaf.)



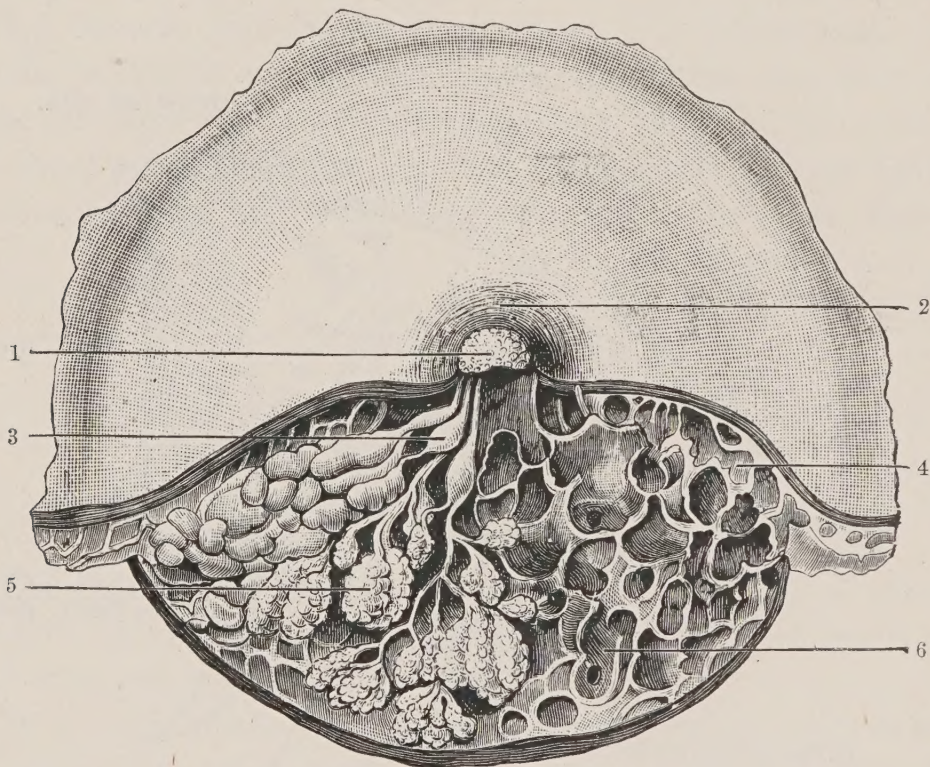
3rd. ITS BLOOD-VESSELS.—These are: (a) the perforating branches of the internal mammary artery from the 3rd and 4th intercostal spaces; (b) the external mammary or long thoracic artery which passes to the gland at the outer border of the pectoralis major; (c) minute twigs from the arteries which end in the pectoral muscles. The veins accompany the arteries.

4th. THE NERVES.—They are derived from: (a) the anterior cutaneous twigs of the 3rd, 4th, and 5th intercostal

nerves; (b) from the anterior twigs of the lateral branches of the same nerves.

5th. THE LYMPHATICS.—Although the lymphatic vessels cannot be seen, their course and termination should be noted now, for along these, infections and malignant tumours spread. The main stream of lymphatics passes towards the axilla. A few glands may be found at the outer border of the pectoralis major (pectoral set), through which a few of the vessels may pass; but most of the vessels pass direct to the *great central*

FIG. 9.—SHOWING THE STRUCTURE OF THE MAMMARY GLAND. (Semi-diagrammatic.)
(After Luschka.)



1. Mamilla, with orifices of lactiferous ducts. 2. Areola. 3. Ampulla of duct. 4. Subcutaneous fat loculi. 5. Acini of lacteal gland. 6. Gland loculi.

set of lymphatic glands situated in the centre of the floor or base of the axilla (fig. 8). The position of this set is marked on the surface by the axillary tuft of hairs. From the central set of glands, the lymph stream passes through deep axillary glands to reach the *inferior deep cervical* glands in the neck. Another stream of lymphatic vessels passes with the anterior perforating veins of the third and fourth spaces to end in glands (anterior intercostal) situated on each side of the internal mammary artery. A few vessels may pass to the *cephalic gland*, situated between the pectoralis major and deltoid muscles.

A SECTION OF THE GLAND.—The dissection of the mammary gland is a difficult and intricate matter (fig. 9). A better conception of the gland may be obtained by following Stiles's method. The gland should be immersed in a 5 per cent. solution of nitric acid for 48 hours. This has the effect of staining the glandular tissue of a brownish tint, while the connective tissue remains pale and easily distinguished. A section should then be made across the gland so that the nipple is also divided.

The student should then be able to make out: (1) The *capsule* of the gland, with trabeculæ or septa passing from its *deep* to its *superficial parts*. The capsule is formed out of the superficial fascia.

(2) The *lactiferous ducts* (there are about 15 of them) passing upwards in the nipple to terminate by separate orifices on the apex. Each duct drains a lobe, and is dilated at the base of the nipple into an ampulla (fig. 9).

(3) The *lobes* are irregular, imperfectly separated, with many outlying semi-detached lobuli extending to some distance from the main lobes. The lobes radiate outwards from the nipple.

(4) A considerable amount of fat within the capsule and interlobar spaces.

Some minor points should also be noted now. The pigmented areola, which surrounds the nipple, is marked by small glandular elevations. The small glands (areolar glands) moisten the areola during lactation. The nipple contains non-striated muscle and a vascular network, capable of causing its erection.

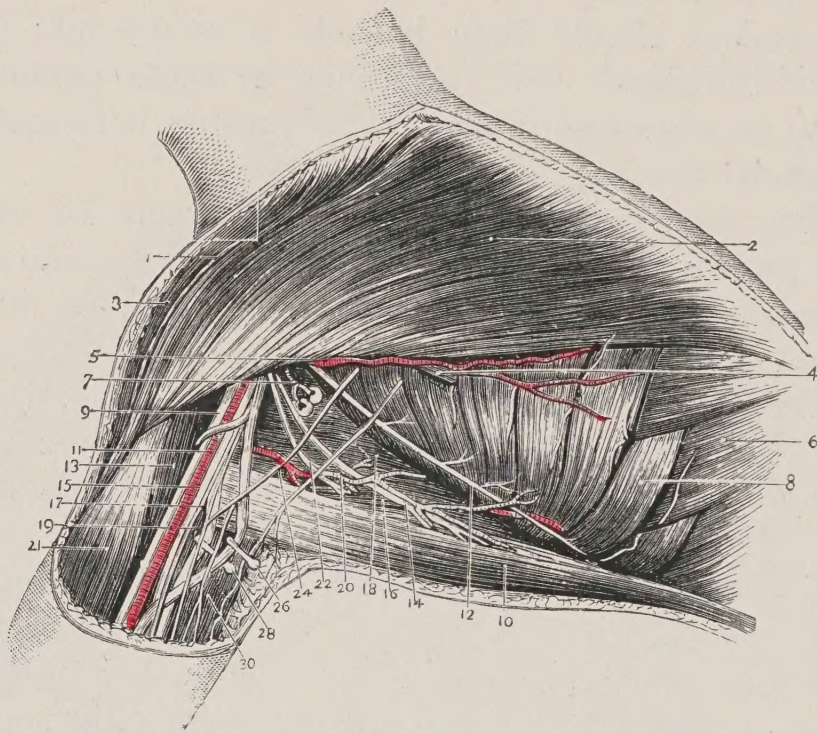
DISSECTION IV

THE AXILLA

The student has now to enter on one of the most difficult and important dissections of the body. He has to open the armpit from below and expose the structures that lie in it, as a surgeon has to do when he clears out spreading colonies of cancer within the axilla. He has to seek out and note the lie of the great axillary vessels and nerves. He has to find the clumps of lymphatic glands which so frequently are the

seat of cancer colonies and abscess. The tuft of axillary hairs marks the situation of the principal set. All these structures have to be made out in a mass of fat and fibrous tissue in which the axillary structures are packed. He should note, too, how the contents of the space may be compressed when the head of the humerus is dislocated into the axilla.

FIG. 10.—SHOWING THE STRUCTURES TO BE DISSECTED WITHIN THE CAVITY OF THE AXILLA. (Heath.)



1. Cephalic vein. 2. Pectoralis major. 3. Deltoid. 4. Pectoralis minor. 5. Long thoracic artery. 6. Obliquus externus. 7. Alar thoracic artery. 8. Serratus magnus. 9. Median nerve. 10. Latissimus dorsi. 11. Axillary artery. 12. Posterior thoracic nerve. 13. Coraco-brachialis. 14. Long subscapular nerve. 15. Ulnar nerve. 16. Teres major. 17. Internal cutaneous nerve. 18. Subscapularis. 19. Nerve of Wrisberg. 20. Subscapular artery. 21. Biceps. 22. Middle subscapular nerve. 24. Intercosto-humeral nerve. 26. Basilic vein becoming axillary vein, held aside by hooks. 28. Musculo-spiral nerve. 30. Triceps.

Having removed the deep fascia, the axilla should be opened up from below by removing a quantity of fat, and the following structures should be found (fig. 10) :

(1) *Intercosto-humeral nerve* (already mentioned), near the lower border of the pectoralis major, crossing the floor from the inner wall towards the hinder part of the outer wall and arm.

(2) The *long thoracic artery*.

(3) Along the posterior wall will be found the *subscapular artery*.

(4) Close to the last, the *long subscapular nerve*.

(5) Extending along the outer wall towards the arm the *axillary vessels* with accompanying *nerves* (see relations of third part of axillary artery, p. 29).

(6) On the inner wall will be found the *posterior thoracic nerve*, passing vertically downwards on the surface of the serratus magnus muscle (fig. 10, 12).

The Axilla.—The axilla is the space which lies between the upper part of the chest and the shoulder. It is somewhat conical in shape, with its base directed to the armpit, while its *apex* extends upwards into the neck beneath the clavicle. The *anterior wall* is formed by the pectoralis major and pectoralis minor muscles, with the costo-coracoid membrane, together with the clavicle and subclavius muscle (fig. 11). The *posterior wall* is formed by three muscles, viz.: subscapularis, teres major, and latissimus dorsi (fig. 10).

The *outer wall* is narrow and formed by the upper end of the humerus, coraco-brachialis and biceps muscles. The *inner wall* is formed by the four upper ribs and intercostal muscles covered by the serratus magnus. The *base* or *floor* is formed by the strong axillary fascia stretching from the anterior to the posterior fold of the axilla. The folds of the axilla are formed by the lower borders of the pectoralis major in front, and of the teres major and latissimus dorsi behind.

The *apex* corresponds to a triangular interval between the clavicle in front, the scapula behind, and the first rib on the inner side; by this interval (cervico-axillary passage) the axillary vessels and brachial nerves enter the axilla from the root of the neck. In the neck these vessels receive the name of subclavian, because they pass under the clavicle as they leave the neck to enter the axilla (fig. 7).

Dissection of the Anterior Wall of the Axilla

Pectoralis Major.—ORIGIN. By two heads.

(1) STERNO-COSTAL HEAD, from the lateral half of the sternum, the costal cartilages from the second to the sixth inclusive, a portion of the sixth rib, and the aponeurosis of the external oblique muscle of the abdomen;

(2) CLAVICULAR HEAD, from the anterior surface of the inner third or even half of the clavicle, and from the anterior sterno-clavicular ligament.

INSERTION.—The fibres converge and are inserted to the pectoral ridge on the outer border of the bicipital groove of the humerus. The clavicular fibres are superficial to the sterno-costal at the ridge of insertion. The sterno-costal fibres, as they pass outwards to the border of the axilla, become reflected inwards and pass beneath the clavicular fibres.

ACTION.—The pectoralis major muscles bring the arms together as in the act of embracing. They adduct the arm, bringing it towards the chest. If the hand is fixed, the muscle may raise the body on the arm. In this action it expands the chest.

NERVE SUPPLY.—From the external anterior thoracic nerve—a branch of the outer cord of the brachial plexus. A branch of the internal anterior thoracic also reaches it. They will be seen when the muscle is reflected (figs. 11 and 12).

THE CEPHALIC VEIN (fig. 11).—Open up the interval between the outer border of the pectoralis major and the deltoid, and find there the cephalic vein and an accompanying artery, viz. the descending branch of the acromio-thoracic artery. The vein begins at the elbow and ends in the axillary vein by piercing the costo-coracoid membrane.

Parts beneath the Pectoralis Major.—Divide carefully the attachment of the pectoralis major to the *clavicle*, to expose the costo-coracoid membrane. There is usually a very evident demarcation between the clavicular and sterno-costal parts of the muscle. The membrane, indistinctly formed near the ribs and sternum, can be traced from the clavicle to the upper border of the pectoralis minor. Trace the attachment of this membrane and the structures piercing it as detailed in the following description (fig. 11).

COSTO-CORACOID MEMBRANE.—This is attached *above* to the clavicle by two layers which enclose the subclavius muscle in a sheath; *below*, it becomes continuous with the sheath of the pectoralis minor. *Externally* it is attached with the insertion of the pectoralis minor to the coracoid process, while *internally* it becomes very thin, lax, and spreads out on the first intercostal space, and becomes attached to the first and second costal cartilages.

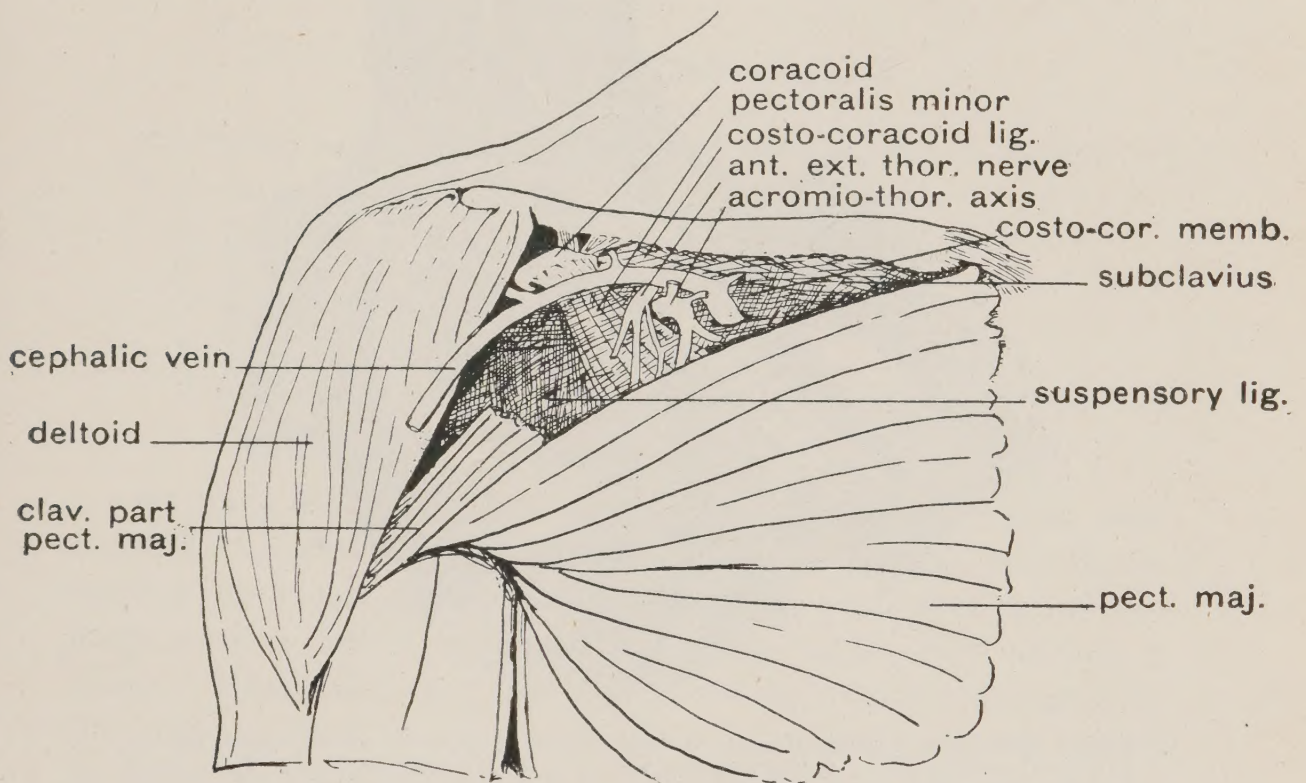
Just below the subclavius a specially thickened band will be felt with the finger in this membrane, extending from the

first rib to the coracoid process. This sometimes receives the name of the *costo-coracoid ligament*.

The membrane with its extension on the pectoralis minor sometimes receives the name of the *clavi-pectoral fascia*.

Piercing the costo-coracoid membrane will be found the following structures (fig. 11): (1) the *cephalic vein*, passing upwards to join the axillary vein; (2) the *acromio-thoracic artery*, with its accompanying *vein*; (3) the *external anterior thoracic nerve*, passing downwards and inwards to supply the pectoralis major.

FIG. 11.—STRUCTURES IN THE ANTERIOR WALL OF THE AXILLA.



SUBCLAVIUS.—Its sheath, formed by the costo-coracoid membrane, must be cut away. The muscle lies so close to the clavicle that it is not easily seen. The dissectors of the head and neck will expose it by removing the middle third of the clavicle.

ORIGIN.—From the upper surface of cartilage of the first rib, external to the rhomboid ligament.

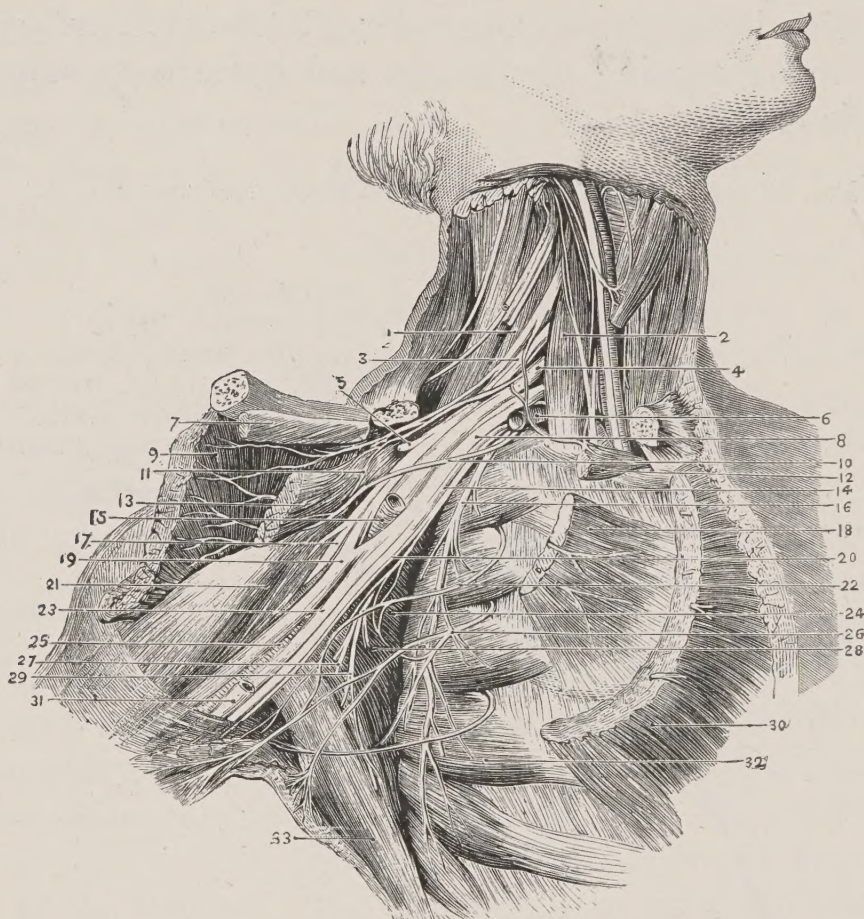
INSERTION.—To the under surface of middle third of clavicle.

ACTION.—The muscle depresses the clavicle and retains its inner end in apposition with the sternum.

NERVE SUPPLY.—Its nerve crosses the subclavian triangle (fig. 12). It comes from the fifth cervical nerve. The dissector of the neck will point it out.

Pectoralis Minor (fig. 11).—To expose this muscle the sternal and costal attachments of the pectoralis major are to

FIG. 12.—THE NERVES OF THE AXILLA. (*Hirschfeld and Leveillé.*)



1. Scalenus medius. 2. Scalenus anticus. 3. Cord formed by fifth and sixth cervical nerves.
4. Seventh cervical nerve. 5. Suprascapular nerve. 6. Subclavian artery (cut). 7. Insertion of subclavius. 8. Cord formed by eighth cervical and first dorsal nerves. 9. Pectoralis major (reflected). 10. Internal anterior thoracic nerve. 11. External anterior thoracic nerve.
12. Origin of subclavius. 13. Pectoralis minor (reflected). 14. Internal cutaneous nerve. 15. Axillary artery (cut). 16. Posterior thoracic nerve (Bell). 17. Musculo-cutaneous nerve. 18. Origin of pectoralis minor. 19. Median nerve. 20. Nerve of Wrisberg.
21. Coraco-brachialis. 22. Intercosto-humeral nerve. 23. Ulnar nerve. 24. Subscapularis. 25. Brachial artery. 26. Lateral cutaneous branch of third intercostal nerve. 27. Middle subscapular nerve. 28. Short subscapular nerve. 29. Long subscapular nerve. 30. Pectoralis major (cut). 31. Basilic vein. 32. Serratus magnus. 33. Latissimus dorsi.

be cut and the muscle reflected outwards. The sheath of the pectoralis minor, continuous with the costo-coracoid membrane above and with the axillary fascia below, through the suspensory ligament (fig. 11), is now to be cleaned off from beginning to end of the muscle.

ORIGIN.—From the anterior extremities of the third, fourth, and fifth ribs (sometimes from second rib), and from

the fascia covering the intercostal muscles in the intervening spaces.

INSERTION.—Into the anterior border of the coracoid process of the scapula, and, by fascia, into the inner border of the coraco-brachialis muscle. The upper fibres may pass directly to the capsule of the shoulder-joint.

ACTION.—It draws the shoulder forwards and inwards.

NERVE SUPPLY.—The internal anterior thoracic nerve, which will be seen rising from the inner cord of the brachial plexus when the muscle is reflected (fig. 12).

CONTENTS OF THE AXILLA

These are now to be dissected and examined. They are :—

1. The Axillary Artery and its branches ;
2. The Axillary Vein and its tributaries ;
3. The Lymphatic Glands and vessels ;
4. The Brachial Plexus and branches ;
5. The connective tissue and fat in which these structures are imbedded.

Axillary Sheath.—As the great vessels for the arm pass from the neck to the axilla beneath the clavicle and subclavius muscle, they carry round them a tubular prolongation of the deep cervical fascia, to which the name of axillary sheath is given. Every artery of the body, and especially great arteries like the axillary, is surrounded by a fibrous sheath. The axillary sheath becomes continuous with the ordinary sheath beneath the pectoralis minor. The costo-coracoid membrane and the sheath are adherent. It may be necessary for the surgeon to expose the axillary artery below the clavicle by cutting through the structures which the student has just dissected. Before a ligature can be applied to the vessel the axillary sheath must be opened.

The Axillary Artery (fig. 13).—It is necessary to make some preliminary dissection before the artery can be clearly seen. The student should freely use the handle of his knife in separating the main structures round the artery. He should then trace out : (1) the *acromio-thoracic artery* to its origin from the axillary ; (2) the *acromio-thoracic vein* to the axillary vein ;

(3) the *cephalic vein* inwards and upwards to the axillary vein ;
(4) the *external anterior thoracic nerve* to the outer cord of the brachial plexus. All of these structures pierce the costo-coracoid membrane.

The artery will be seen between the pectoralis minor and clavicle, with the axillary vein to its inner side, and the three cords of the brachial plexus on its outer side and partly surrounding it. It can be dissected out more thoroughly after the pectoralis minor is reflected.

Cut through the pectoralis minor near its costal attachment and reflect it outwards. Search for the *internal anterior thoracic nerve*, which enters its under surface, and for a twig which connects this nerve across the axillary artery with the external anterior thoracic nerve. Next remove the axillary fat and clean the axillary artery, with the structures found in relation to it (figs. 8, 10, and 12). In doing this the student will find a free use of the handle of his knife advantageous in separating the main structures.

COURSE OF THE AXILLARY ARTERY.—The axillary artery is a continuation of the subclavian. It commences at the outer border of the first rib and extends to the lower border of the teres major, where it is continued down the inner side of the arm as the brachial (fig. 13). The *line* of the artery varies with the position of the arm. When the arm is placed close to the side the artery forms a gentle curve, the convexity of which is upwards and outwards ; while if the arm is drawn outwards at right angles to the body, the course of the artery may be represented by drawing a straight line from the middle of the clavicle to the inner border of the coraco-brachialis. By prolonging this line to a point midway between the two condyles of the humerus, the line of the continuous axillary and brachial arteries will be shown. The artery enters the axilla beneath the clavicle through the triangular cervico-axillary passage. It is divided into three stages or parts.

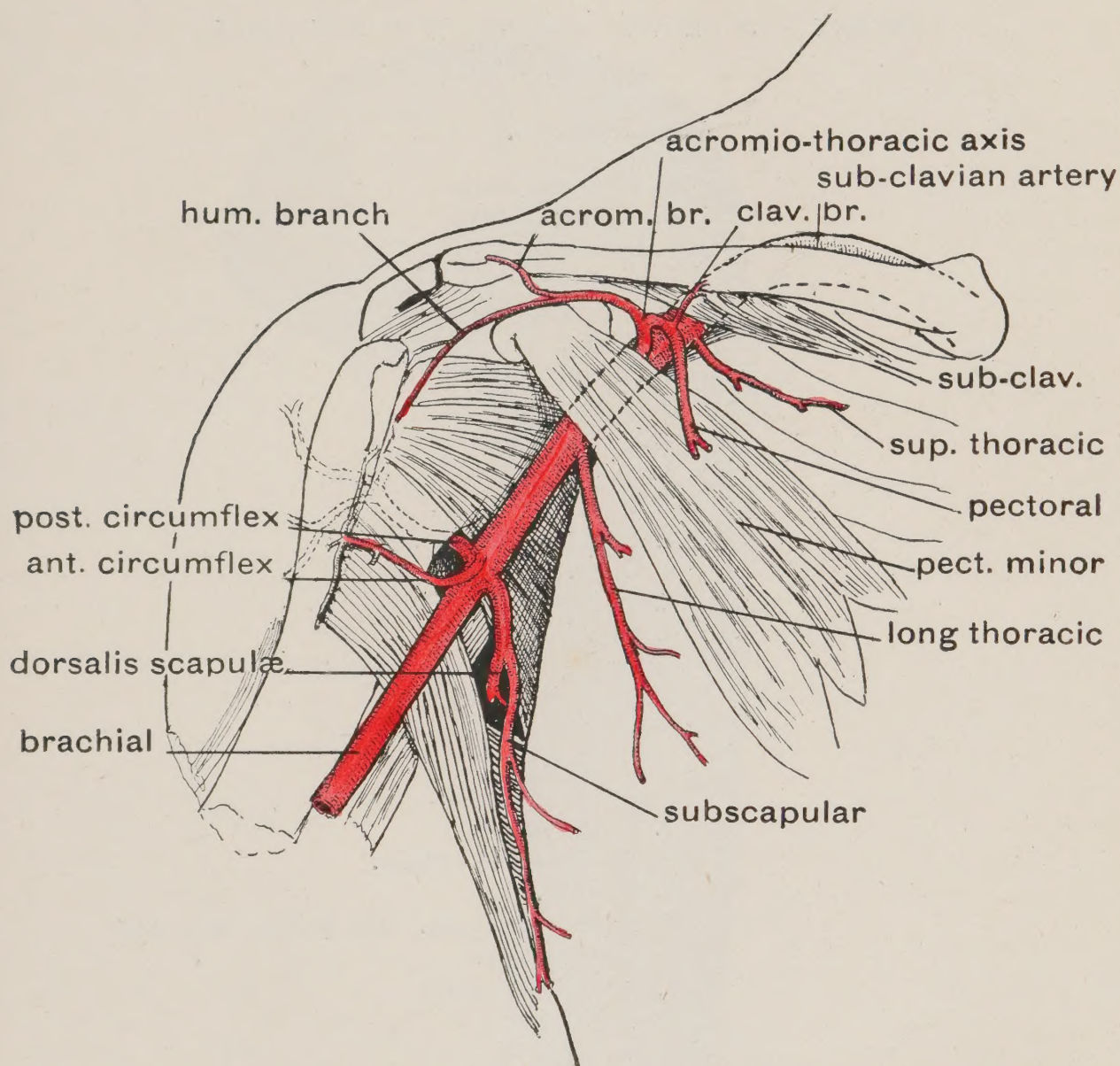
THE STAGES OF THE AXILLARY ARTERY.—The *first part* of the axillary artery extends from the outer border of the first rib to the upper border of the pectoralis minor, being deeply placed at the upper part of the axilla. It varies somewhat in its length, being usually an inch, but may be shorter when the pectoralis minor arises from the second rib.

RELATIONS.—*In front.*—Skin, superficial and deep fascia

with pectoralis major, costo-coracoid membrane, clavicle and subclavius, cephalic vein, acromio-thoracic vessels and external thoracic nerve.

Behind.—First intercostal space and muscle, serratus magnus and posterior thoracic nerve.

FIG. 13.—THE STAGES AND BRANCHES OF THE AXILLARY ARTERY.



Inner side.—Axillary vein and commencement of the internal anterior thoracic nerve.

Outer side.—Three trunks of brachial plexus of nerves.

The SECOND PART OF AXILLARY ARTERY lies behind the pectoralis minor.

RELATIONS.—*In front.*—Pectoralis minor, pectoralis major, integument and fascia.

PLATE II.

ARTERY AND NERVES PASSING FROM THE AXILLA TO THE ARM.

Muscles.

- A. Pectoralis major.
- B. Latissimus dorsi.
- C. Subscapularis.
- D. Coraco-brachialis.
- E. Long head of triceps.
- F. Biceps.
- G. Brachialis anticus.
- H. Deltoid.

Nerves.

- 1. Internal cutaneous.
- 2. Ulnar.
- 3. Median.
- 4. Musculo-cutaneous.
- 5. Lesser internal cutaneous.
- 6. Musculo-spiral.

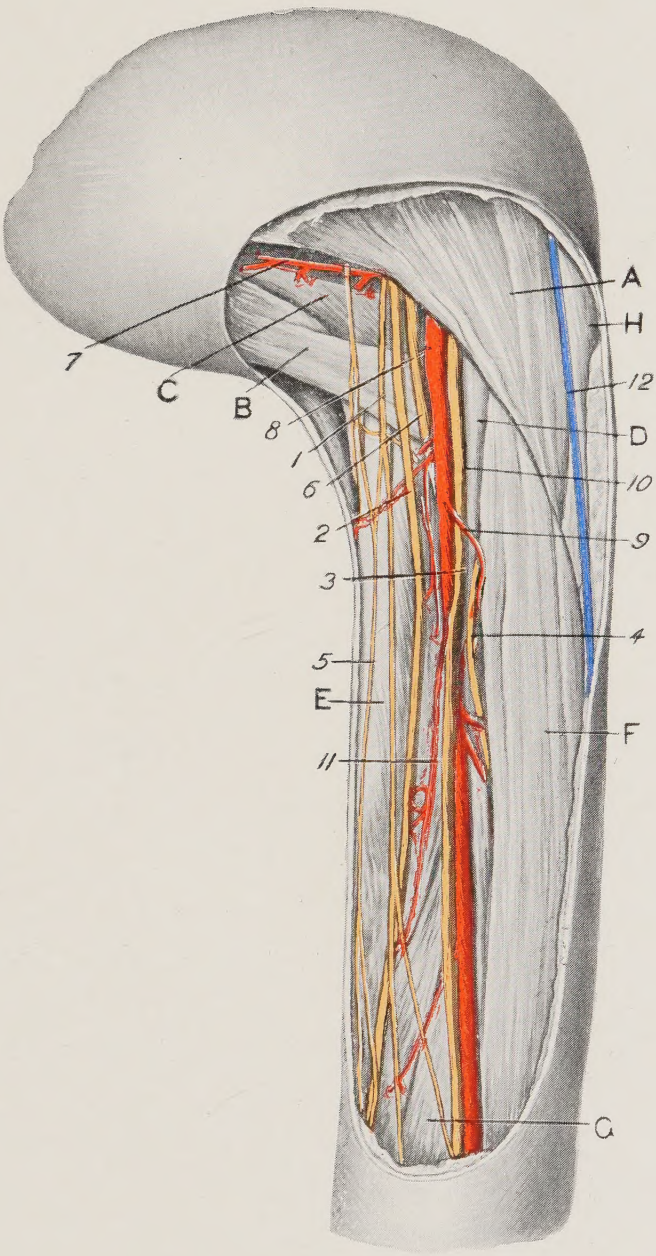
Arteries.

- 7. Long thoracic.
- 8. Third stage of axillary.
- 9. Brachial.
- 10. Superior profunda. The pointer falls short of the artery.
- 11. Inferior profunda.

Vein.

- 12. Cephalic.

PLATE II.



Behind.—Posterior cord of brachial plexus, subscapularis, with some fat intervening.

Outer side.—Outer cord of brachial plexus (fig. 12).

Inner side.—Inner cord of brachial plexus and axillary vein.

The THIRD PART OF AXILLARY ARTERY (Plate II) lies beyond the pectoralis minor. It is in part deeply situated within the axilla, and in part superficial beyond the lower border of the pectoralis major.

RELATIONS.—*In front.*—Pectoralis major, integument and fascia, internal cutaneous nerve, inner head of median nerve, which crosses it obliquely.

Behind.—Subscapularis, teres major and latissimus dorsi, musculo-spiral and circumflex nerves.

Inner side.—The veins which unite to form the axillary trunk, branches of the inner cord of the brachial plexus, viz. ulnar, inner head of the median nerve, internal cutaneous and lesser internal cutaneous nerves (fig. 12).

Having studied the course of the axillary artery so as to be able at any time to thread his way to it through the intricate arrangement of surrounding structures, the student should now examine the distribution of the branches arising from each stage of the axillary artery (fig. 13).

Branches of the Axillary Artery.

FIRST PART.

- (1) Superior thoracic ;
- (2) Acromio-thoracic.

SECOND PART.

- (3) Alar thoracic ;
- (4) Long thoracic.

THIRD PART.

- (5) Subscapular ;
- (6) Anterior circumflex ;
- (7) Posterior circumflex.

VARIATION IN THE ARRANGEMENT OF STRUCTURES. — As in the human face, so in the arrangement of branches of the axillary artery, and the same is true of every structure in the body, no two individuals show exactly the same form. There is a variation in detail, although in the main points all are alike. The student may find, for instance, that the

superior thoracic artery or the alar may not arise in the manner described here; occasionally they spring from surrounding larger branches. It is not uncommon to find the posterior circumflex and subscapular branches of the axillary artery arising by a common trunk. When the student encounters a discrepancy between the description given here and the actual arrangement in his part, he must regard the arrangement in his part as being much less frequent than that described.

(1) The SUPERIOR THORACIC ARTERY passes to the first intercostal space near the upper border of the pectoralis minor, and ramifies on this space and on the pectoralis minor. It anastomoses with other arteries in the space; it is frequently very small and sometimes absent.

(2) The ACROMIO-THORACIC ARTERY (thoracic axis) is a short trunk given off immediately above the pectoralis minor. It pierces the costo-coracoid membrane (where it has already been seen) and divides into the following branches:

(a) *Acromial*, which extends outwards, either beneath or through the deltoid to reach the acromion process. There it forms a plexus with the circumflex and branches of the subscapular arteries;

(b) *Clavicular*, which passes upwards to the clavicle and subclavius muscles;

(c) *Pectoral* or *thoracic*, which pass inwards to supply the pectoral muscles, wall of the chest, and mamma;

(d) *Descending* or *humeral branch*, which descends between the pectoralis major and deltoid muscles, with the cephalic vein, to supply these muscles. It anastomoses with the circumflex arteries.

(3) The ALAR THORACIC are small twigs given off to the fat and glands of the axilla.

(4) The LONG THORACIC ARTERY extends along the lower border of the pectoralis minor; it supplies the pectoral muscles, the serratus magnus and integumentary structures of the chest, including the mammary gland. The long thoracic anastomoses with branches of the intercostal and internal mammary arteries.

A large special branch of the long thoracic may occur in the female for the supply of the mammary gland; such a branch receives the name of *external mammary*. It may arise independently from the axillary artery.

(5) The SUBSCAPULAR ARTERY is given off near the lower border of the subscapularis muscle, along which it passes towards the inferior angle of the scapula and wall of the chest. There it terminates by anastomosing with branches of the posterior scapular, dorsalis scapulæ and long thoracic arteries.

It is accompanied in a part of its course by the long subscapular nerve.

Near its commencement it gives off a large branch, the *dorsalis scapulæ*, which passes through a triangular interval between the subscapularis, teres major, and long head of the triceps, to reach the dorsal surface of the scapula (fig. 13). It grooves the axillary border of the scapula and passes beneath the teres minor. Having reached the infra-spinous fossa it ramifies beneath the infra-spinatus muscle, anastomosing freely with the supra-scapular and posterior scapular arteries. It gives off also a branch which enters the bone just below the scapular spine.

As the dorsalis scapulæ traverses the triangular space it gives off the *infra-scapular artery* which passes beneath the subscapularis muscle to ramify on the ventral aspect of the scapula.

(6) The ANTERIOR CIRCUMFLEX (fig. 13) is a small artery which passes transversely outwards beneath the coraco-brachialis and biceps to reach the anterior surface of the surgical neck of the humerus. Across the bicipital groove it anastomoses with branches from the posterior circumflex. It gives off a small branch which ascends in the bicipital groove and supplies the shoulder-joint.

(7) The POSTERIOR CIRCUMFLEX ARTERY is much larger than the anterior. It arises from the posterior aspect of the axillary artery, opposite the lower border of the subscapularis muscle. It then passes backwards through the *quadrilateral space* (fig. 13). The space is bounded above by the subscapularis, below by the teres major, internally by the long head of the triceps, and externally by the surgical neck of the humerus. Having passed through this space it winds round the surgical neck of the humerus in company with the circumflex nerve. Reaching the under surface of the deltoid it divides into a number of branches, some of which anastomose with the anterior circumflex and superior profunda arteries, while the remainder enter the substance of the muscle.

PERI-ARTICULAR ANASTOMOSES.—Branches from the circumflex arteries end in the shoulder-joint. At a later stage, other arteries will be found to contribute to the blood supply of this joint, the supra-scapular, dorsalis scapulæ and acromial arteries. The ramifications and anastomoses of these arteries form a deep and a superficial plexus round the shoulder-joint. The student will find that this arrangement is not limited to the shoulder-joint; the same plexus-like arrangement surrounds all the great articulations of the upper and lower limbs.

Veins of the Axilla.—Three fairly constant veins enter the axilla from the arm, viz. the *basilic* and the two *venæ comites* of the brachial artery. These three usually unite to form the axillary vein at the lower border of the pectoralis minor. The subscapular vein joins at their point of union. Thus the axillary vein has only two stages corresponding to the first and second stages of the artery. It extends upwards on the inner and anterior aspects of the axillary artery. At the outer border of the first rib it passes under the clavicle and becomes the subclavian vein. In life, when the vein is full, it almost completely hides the artery, and its superficial position makes it more liable to be wounded than the artery during operations in the axilla. The walls of the vein are bound to the structures under the clavicle; the blood within it is subject to respiratory movements propelled from the thorax.

TRIBUTARIES.—It receives tributaries corresponding to the branches of the axillary artery, and near its termination it is joined by the cephalic vein.

The Lymphatic Glands of the Axilla (fig. 8).—The student's attention has already been directed to these glands (page 18). He cannot pay them too much attention, for in practice they are, of all the structures in the axilla, the ones which most require treatment. In aged bodies, they are atrophied and, unless diseased and enlarged, may be removed unheeded in the fat and fibrous tissue. They may be grouped in four sets:—

(1) CENTRAL SET, situated in the floor of the axilla, near its middle (fig. 8). The axillary tuft of hair marks its position. There are ten or twelve glands in this group. Lymph from the arm and breast is poured into them by lymphatic vessels, and hence they enlarge in diseases of those parts. They lie near the axillary vein and its tributaries.

(2) PECTORAL SET, consisting of a few glands at the outer

border of the pectoralis major. This set is often absent. It receives lymph from the mamma and anterior thoracic wall.

(3) SUBSCAPULAR SET (four or five glands), near the termination of the subscapular vein in the axillary. This set receives lymph from the scapular region of the back, as low down as the iliac crest.

(4) DEEP AXILLARY SET (six or eight glands) is scattered in the fibrous tissue along the anterior and inner surfaces of the axillary vein. It receives lymph from the central set.

The Brachial Plexus.—The dissector of the head and neck has by this time examined the parts above the clavicle and exposed the contents of the subclavian (supra-clavicular) triangle. The dissector of the upper extremity should now seek his aid in unravelling the intricacies of the brachial plexus, for it lies behind the clavicle in both neck and axilla. To expose it, the middle third of the clavicle, if not already removed, should be cut away and the subclavius muscle with it. The shoulder then falls backwards, exposing the plexus freely. The axillary vessels should be divided at the outer border of the first rib and drawn forwards. Much tough fibrous tissue surrounds the plexus and requires patient dissection. Were it not for this tough protecting sheath of fibrous tissue the brachial plexus would be strained every time a heavy burden was carried on the shoulder. The plexus is made up of five spinal nerves which issue at the intervertebral foramina from the spinal cord in the lower part of the neck. The manner in which spinal nerves spring from the spinal cord can be seen by referring to figs. 1 and 14.

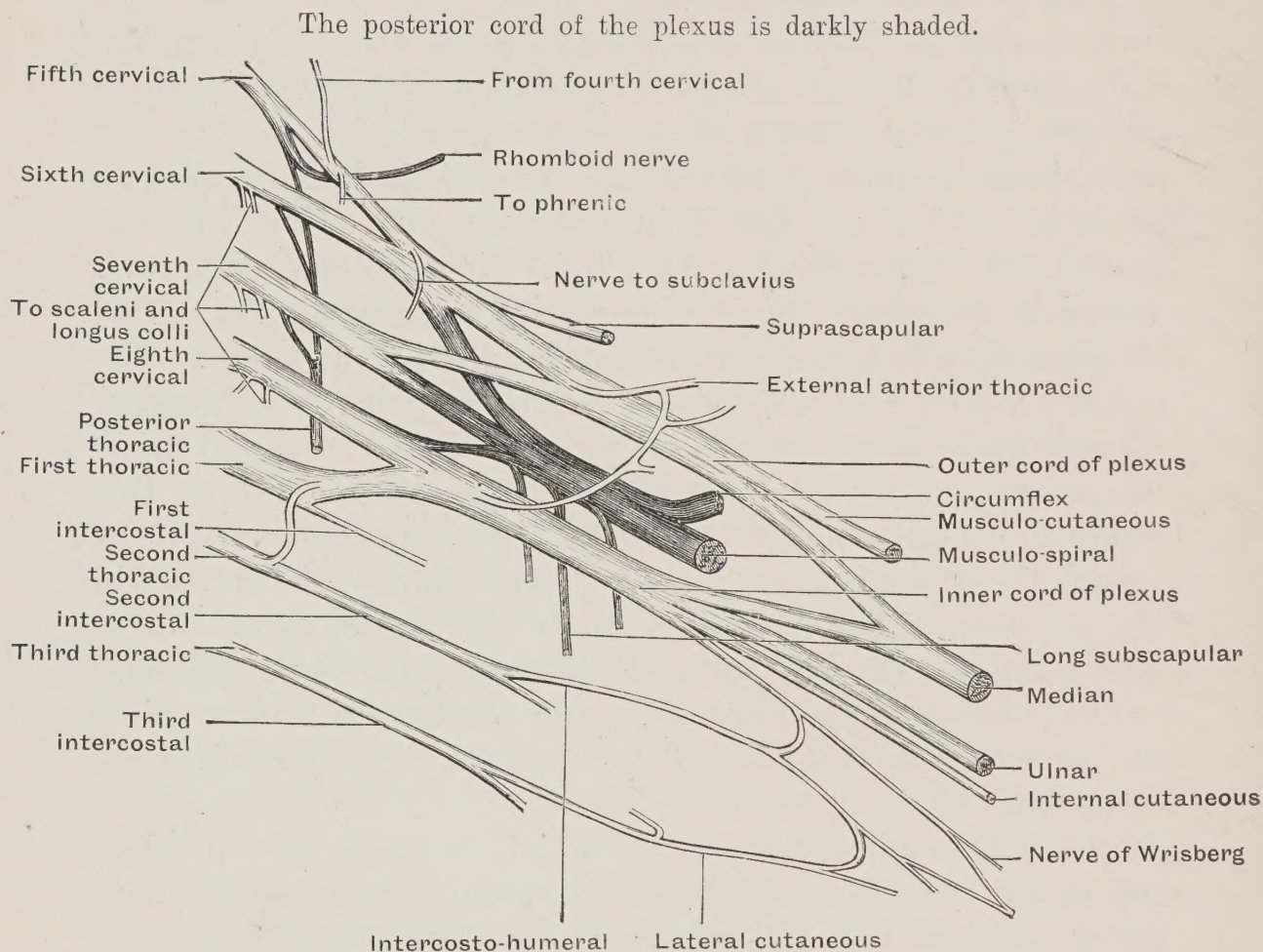
The five spinal nerves which join to form the brachial plexus are the fifth, sixth, seventh, eighth cervical and first dorsal. Minor fasciculi are added from the second dorsal and fourth cervical. These spinal nerves are the highways whereby motor impulses reach the arm and sensory impulses pass to the cord and brain.

To see the cords and their branches the student should use the handle of his knife freely. The branches of the posterior cord require very careful cleaning.

THE FORMATION OF THE PLEXUS.—The manner in which the spinal nerves mentioned above form the plexus is the following (fig. 14). They emerge between the anterior and middle scalene muscles to lie in the supra-clavicular portion

of the posterior triangle. Here three main *trunks* are formed, an *upper* trunk by the junction of the fifth and sixth cervical, a *middle* trunk by the seventh cervical, and a *lower* trunk by the junction of the eighth cervical and first dorsal nerves. These trunks lie in close relation to the third part of the subclavian artery, the upper and middle trunks being above the artery, while the lower trunk lies behind it. As these trunks pass under the clavicle to reach the axilla, they each separate into

FIG. 14.—DIAGRAM OF THE BRACHIAL PLEXUS. (From Morris's 'Anatomy.')
The posterior cord of the plexus is darkly shaded.



two *divisions* (anterior and posterior). The three posterior divisions unite to form the *posterior cord* of the plexus. The anterior divisions of the upper and middle trunks unite to form the *outer cord* of the plexus, while the *inner cord* is formed by the anterior division of the lower trunk.

It will thus be seen that the brachial plexus resolves itself into four stages: (1) the stage of *spinal nerves*; (2) the stage of *trunks*; (3) the stage of *divisions*; (4) the stage of *cords*. The cords are formed round the second stage of the axillary artery. Round the third stage the cords break up into the

nerves of the arm. While such is the typical arrangement, minor modifications are very frequent.

RELATIONSHIP TO THE AXILLARY ARTERY.—The three trunks thus formed lie on the outer side of the axillary artery in its first part, but in its second part the artery has insinuated itself between the cords, so that the inner cord lies on the inner side, the outer cord on the outer side, and the posterior cord behind the artery (fig. 12).

Branches of the Brachial Plexus (fig. 14).—A. ABOVE THE CLAVICLE. (1) A communicating twig from the fifth nerve to the phrenic (fig. 14).

(2) Muscular branches to the scalene and longus colli muscles from the lower three cervical nerves. They will be seen when those muscles are dissected.

(3) The *nerve to the rhomboid muscles* arises from the fifth nerve and pierces the outer border of the scalenus medius; it then disappears beneath the levator anguli scapulæ, which it supplies in part, and is afterwards continued onwards to supply the rhomboid muscles (major and minor).

(4) The *posterior thoracic nerve* (of Bell) (fig. 14) arises from the fifth and sixth nerves, receiving also a twig from the seventh. It pierces the outer border of the scalenus medius. It then extends vertically downwards on the serratus magnus, crosses behind the first part of the axillary artery and is distributed on the surface of the serratus magnus, to the various digitations of which it gives twigs.

(5) The *nerve to the subclavius* (fig. 14) is a branch of the fifth cervical nerve. Having given off a twig, which extends inwards to join the phrenic nerve, it passes downwards in front of the third part of the subclavian artery and enters the deep surface of the subclavius muscle.

(6) The *supra-scapular nerve* (fig. 14) is given off from the trunk formed by the fifth and sixth nerves and crosses the posterior triangle just below the omo-hyoid muscle. It follows this muscle to the upper border of the scapula, and passes through the supra-scapular notch to reach the dorsum of the scapula. In the supra-spinous fossa, as will be seen presently, it supplies the supra-spinatus muscle and gives a branch to the shoulder-joint. Finally, it passes beneath the acromion process to reach the infra-spinous fossa, where it terminates in the infra-spinatus muscle.

B. BRANCHES OF THE BRACHIAL PLEXUS IN THE AXILLA. These are derived from the three cords of the plexus, some being distributed to the walls of the axillary space, viz. the two anterior thoracic and the three subscapular nerves, while others are distributed to the other parts of the upper extremity (Plate II).

From the *outer cord*.—External anterior thoracic. Outer head of median. Musculo-cutaneous (fig. 14).

From the *inner cord*.—Internal anterior thoracic. Inner head of median. Ulnar. Internal cutaneous. Lesser internal cutaneous (nerve of Wrisberg).

From the *posterior cord*.—Three subscapular nerves. Circumflex. Musculo-spiral.

Only the axillary portion of these nerves can now be traced; the remaining parts will be followed and described with the further dissections of the extremity.

BRANCHES DISTRIBUTED IN THE AXILLA.—(1) The *external anterior thoracic nerve* (fig. 12) has already been seen to end in the pectoralis major. It extends from the outer cord across the first stage of the axillary artery. It pierces the costo-coracoid membrane and enters the pectoralis major. A loop in front of the axillary artery joins it with the *internal anterior thoracic*.

(2) The *internal anterior thoracic nerve* (fig. 12) arises from the inner cord of the plexus, and appears between the axillary artery and vein. It gives branches to the pectoralis minor. Having been joined by the loop above mentioned, it distributes branches which pierce the pectoralis minor and reach the pectoralis major.

(3) The *three subscapular nerves* (fig. 12) are derived from the posterior cord. They have to be sought for in the fat and fibrous tissue in the posterior axillary wall.

(a) The *upper or short subscapular* lies in the upper part of the axilla, behind the axillary vessels, and supplies the subscapularis muscle.

(b) The *middle or long subscapular* extends obliquely downwards on the posterior wall of the axilla, close to the subscapular artery, and enters the latissimus dorsi.

(c) The *lower subscapular* supplies the teres major and gives a few twigs to the lower part of the subscapularis.

(4) The *circumflex nerve* is given off from the posterior cord below the subscapular nerves and beneath the third part

of the axillary artery. It extends downwards and backwards with the posterior circumflex artery through the quadrilateral space, bounded by the subscapularis, the teres major, the long head of the triceps and surgical neck of the humerus (fig. 16). It winds round the humerus to reach the under surface of the deltoid, where it will be traced later (Plate III).

BRANCHES OF THE CIRCUMFLEX NERVE.—(a) Twigs to the *shoulder-joint*.

(b) Nerve to *teres minor*. This has an elongated gangli-form enlargement upon it. The above branches are given off as the nerve winds round the humerus, and, with the two following branches, will be more conveniently examined at a later stage of dissection.

(c) *Cutaneous branches* (fig. 16) to supply the skin over the lower two-thirds of the deltoid and to the skin for a short distance below the insertion of the muscle. The upper ones pierce the deltoid to reach the skin, while the lower ones wind round its posterior border.

(d) *Branches to the deltoid*.

The *terminal branches* of the brachial plexus will be traced later. They are the median, musculo-cutaneous, musculo-spiral, ulnar, and two internal cutaneous nerves (fig. 14).

The Serratus Magnus.—In order to see this great muscle, which rotates and moves the scapula on the chest-wall, the student should cut through the upper part of the axillary artery, if not already divided, with the accompanying cords of the brachial plexus. By throwing these structures outwards and drawing the scapula away from the wall of the thorax, the axillary surface of the serratus magnus is fully exposed. It is well to tie together the vessels and plexus at the point of section.

ORIGIN.—The muscle consists of three portions, which arise from the eight upper ribs. It covers the inner wall of the axilla.

The *upper portion* arises by two digitations from the first and second ribs; a part of this appears in the root of the neck, forming part of the floor of the posterior triangle.

The *middle portion* arises by three digitations from the second, third, and fourth ribs.

The *lower portion* usually arises by four digitations from the fifth, sixth, seventh, and eighth ribs. The origin of this part interdigitates with the upper part of the external oblique muscle of the abdomen.

INSERTION.—The fibres of the muscle pass backwards on the inner wall of the axilla to reach a narrow surface on the ventral aspect and along the posterior or vertebral border of the scapula. The upper portion is attached near the upper angle of the scapula. The lower portion is very thick, and is inserted to the broad area near the inferior angle, while the middle portion forms a thin layer which is inserted near the vertebral border of the scapula, between the upper and lower thickened parts (Plate IV).

ACTION.—If the three portions contract at the same time, the scapula, held outwards by the clavicle, is moved forwards on the wall of the thorax. Through it the weight of the body can be thrown into a blow given straight from the shoulder. If the lower portion acts alone, the lower angle of the scapula is rotated downwards and forwards. If the arms are supported, the muscle may raise the ribs and act as a muscle of inspiration.

NERVE SUPPLY.—The posterior thoracic nerve, sometimes called the nerve of Bell. If this nerve is paralysed the digitations of the serratus magnus are no longer visible on the side of the thorax when the arm is raised, and the lower angle of the scapula protrudes outwards.

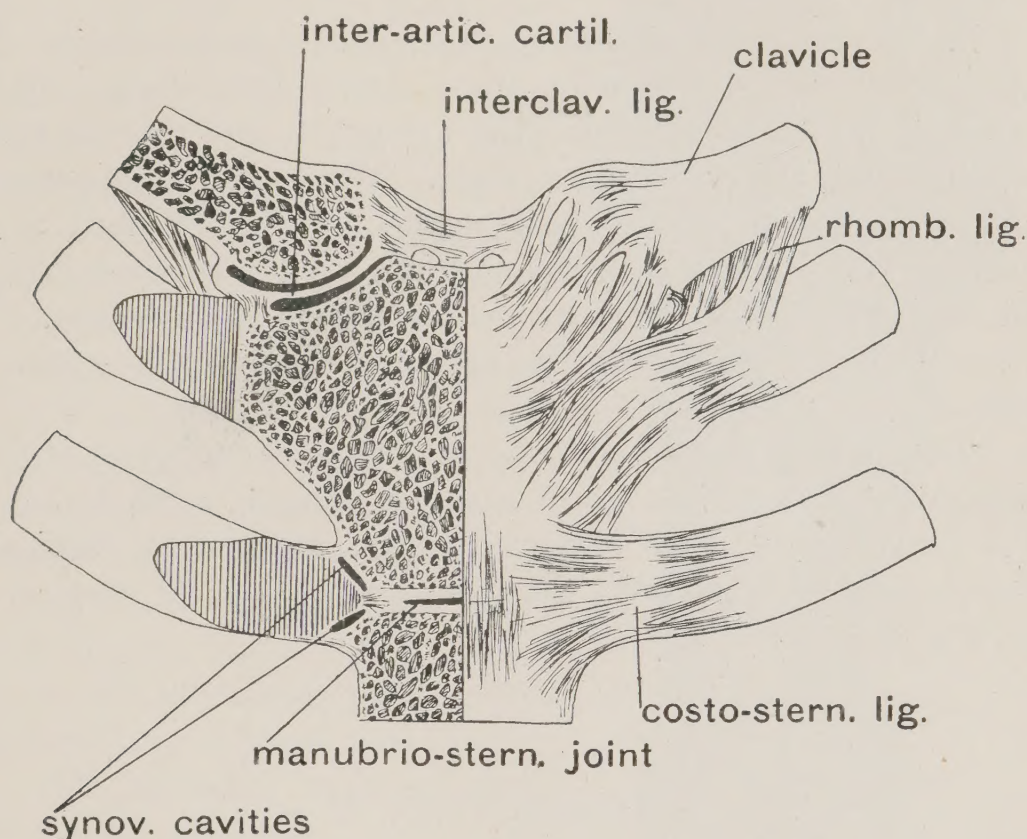
REMOVAL OF THE ARM FROM THE BODY.—The student will find that the only structure which now binds the arm to the body is the serratus magnus. Bit by bit he has cut through the muscles which moved the limb on the trunk, the arteries and veins which supplied it with blood and drained it, the nerves which gave it the power to move and feel, and the clavicle, its sole bony support. With the division of the serratus magnus, the greater part of which is left attached to the chest-wall, the arm is removed and the dissection of the shoulder proceeded with.

Sterno-clavicular Joint and Ligaments.—Before proceeding with the dissection of the arm, now removed, the student should ask the dissector of the head and neck to examine with him the structures that unite the inner end of the clavicle to the body.

The sternal origin of the sterno-mastoid should be detached, so as to expose the capsule of the sterno-clavicular joint. He should now examine (fig. 15) :

1. The *anterior sterno-clavicular ligament* which crosses the joint in front from the clavicle above to the sternum below. It forms part of the capsular ligament. The fibres are densely packed and strong.

FIG. 15.—SECTION OF STERNO-CLAVICULAR JOINT TO SHOW THE INTER-ARTICULAR FIBRO-CARTILAGE. (H. Bailean.)



2. The *interclavicular ligament* passes between the inner extremities of the clavicle. Loose fibres bind it to the supra-sternal notch. This is not a ligament of great strength.

3. The *interarticular fibro-cartilage* should be exposed by such a section as is shown in fig. 15. The cartilage is thus seen in section. It forms a buffer between the clavicle and sternum, and divides the synovial cavity into an inner and outer space. The fibro-cartilage or meniscus is attached above to the clavicle, and below to the sternum at the termination of the cartilage of the first rib. Its circumference is attached to the capsular ligament. It adapts the incongruous articular surfaces of the joint.

4. The *rhomboid* or *costo-clavicular ligament* is made up of short fibres which pass from the upper surface of the first costal cartilage to an impression on the lower surface of the clavicle near the inner extremity (fig. 15). The ligament strengthens the sterno-clavicular joint and binds the clavicle to the first rib.

5. The *superior and posterior sterno-clavicular ligaments* bind the sternum and clavicle together above and behind the joint. They are parts of the capsular ligament and of great strength.

6. The *articular surfaces of the clavicle and sternum*. The clavicular surface is convex from above downwards, slightly concave from before back; the sternal is the reverse and is smaller than the clavicular surface. When the arm hangs by the side, only the lower half of the articular surface of the clavicle is in contact with the sternum; when the arm is raised the upper half also comes into contact with the sternum. The breadth of the clavicular articular surface is greater than the sternal.

The clavicle should be detached from the sternum, without separating it from the sterno-mastoid muscle, so as to expose the joint freely. The clavicle is then replaced *in situ*, as it forms a valuable guide to the structures which lie deep in the root of the neck.

DISSECTION V

THE REGION OF THE SHOULDER

The skin is to be removed from the shoulder and the upper half of the arm (brachium). This is best done by making a vertical incision along the anterior border of the biceps muscle. The skin is then reflected outwards and inwards.

Cutaneous Nerves.—At present the aim of the student is to expose the deltoid muscle. In the subcutaneous tissue over this muscle the following nerves should be found:

(1) The supra-acromial branches of the descending cervical nerves (fig. 6). They end in the skin over the anterior and middle part of the deltoid muscle.

(2) The cutaneous branches of the circumflex nerve

(Plate III). These nerves are best found by keeping a sharp outlook for them as the sheath of the deltoid muscle is removed. The sheath is removed by an incision along the middle part of the muscle, from the acromial origin to the humeral insertion. The sheath is then reflected, first forwards and then backwards, the knife being plied along the line of the fibres so as to divide the septa which enter the muscle from the sheath. Nerve twigs of the circumflex pierce the muscle to reach the skin, but the larger branches appear along the posterior border of the muscle.

The Superficial Vessels.—

(1) The *cephalic vein* in the interval between the anterior border of the deltoid and pectoralis major.

(2) The *humeral artery* with the cephalic vein.

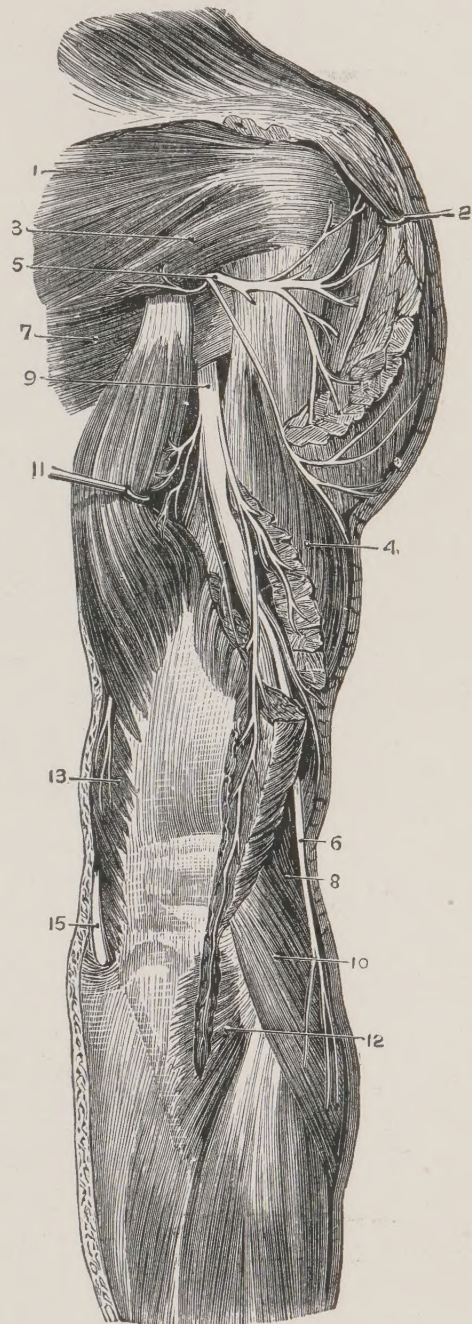
(3) The *acromial artery* from the acromio-thoracic axis.

(4) *Cutaneous twigs* of the circumflex arteries.

The Deltoid.—**ORIGIN.** From the anterior border of the outer third of the clavicle, from the outer border of the acromion process, and from the lower border of the spine of the scapula; some fibres also arise from the thick fascia over the infra-spinous fossa.

INSERTION.—By a strong V-shaped tendon to a rough impression on the outer surface of the humerus a little above its middle point. The anterior

FIG. 16.—CIRCUMFLEX AND MUSCULO-SPIRAL NERVES. (*Hirschfeld and Leveillé.*)



1. Infra-spinatus. 2. Deltoid. 3. Teres minor.
4. Outer head of triceps. 5. Circumflex nerve. 6. External cutaneous branch of musculo-spiral nerve. 7. Teres major.
8. Supinator longus. 9. Musculo-spiral nerve. 10. Extensor carpi radialis longior.
11. Middle head of triceps. 12. Anconeus. 13. Inner head of triceps. 15. Ulnar nerve.

PLATE III.

STRUCTURES BENEATH THE POSTERIOR PART OF THE DELTOID.

Muscles

- A. Spinous part of deltoid.
- B. Infra-spinatus.
- C. Teres minor.
- E. Teres major.
- F. Long head of triceps.
- G. External head of triceps.

Arteries.

- 1. Posterior circumflex.
- 2. Dorsalis scapulæ

Nerves.

- 3. Circumflex.
- 4. Nerve to teres minor.
- 5. Cutaneous branch of circumflex.

PLATE III

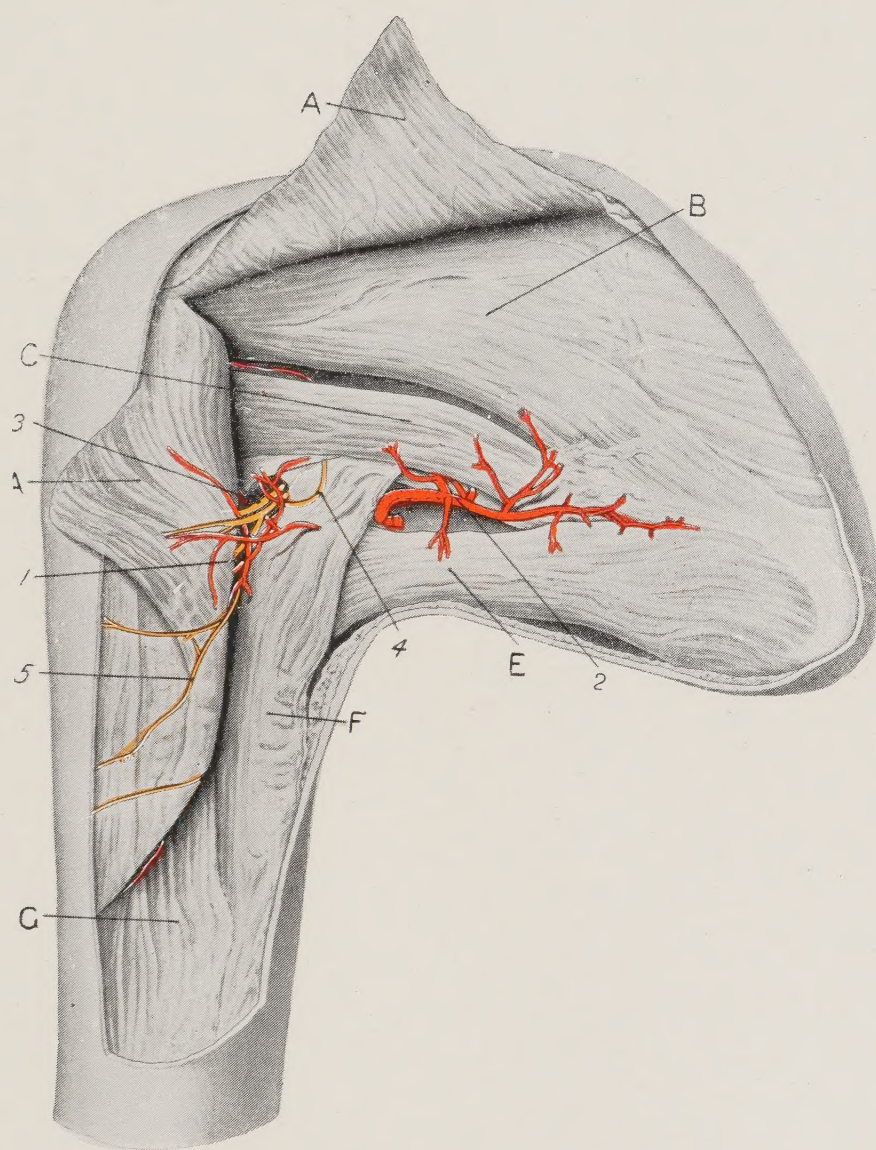


PLATE III.

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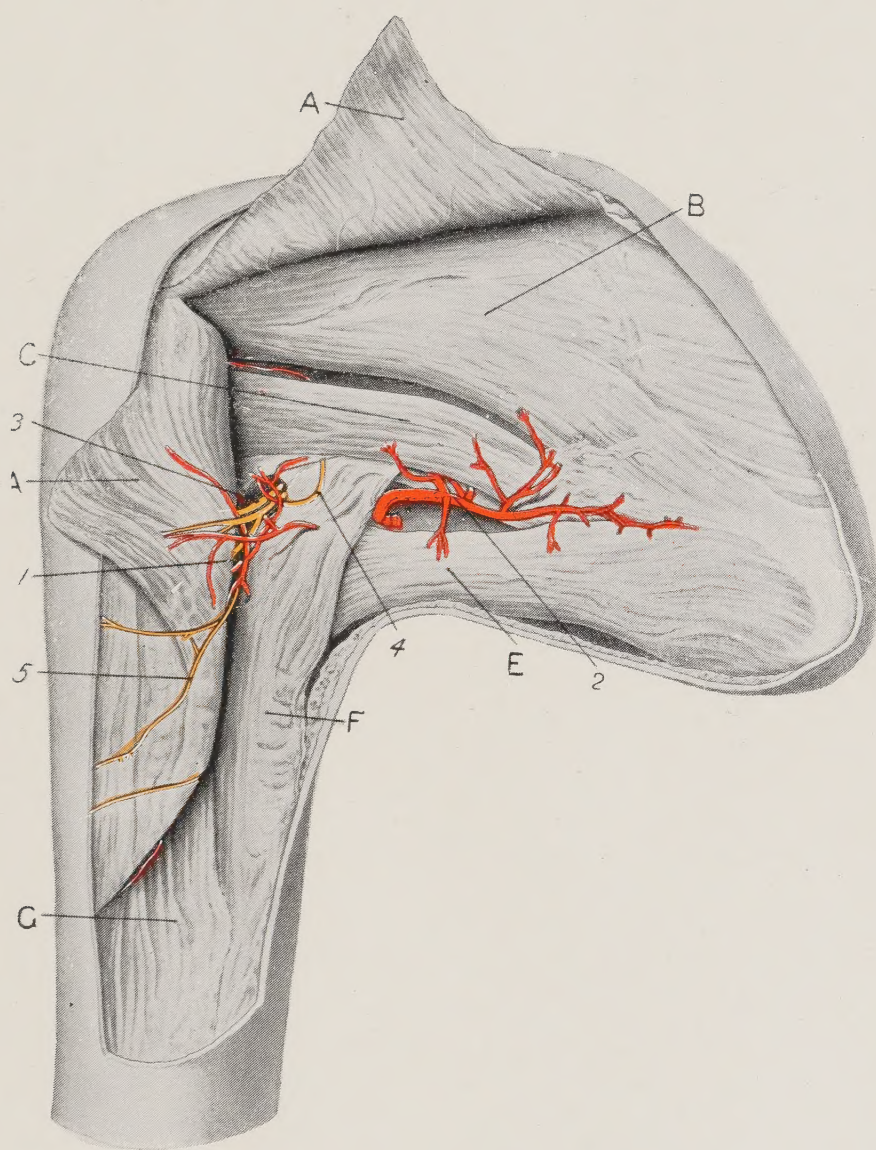
Arteries.

- 1. Posterior circumflex.
- 2. Dorsalis scapulæ

Nerves.

- 3. Circumflex.
- 4. Nerve to teres minor.
- 5. Cutaneous branch of circumflex.

PLATE III



arm, that the head of the humerus rotates under the deltoid muscle. To allow the rotation to take place without undue friction, a large space or sac with a smooth lubricated lining surrounds the outer surface of the head of the humerus and separates it from the overlying deltoid and acromion. The sac has a membranous wall continuous with the surrounding connective tissue. Open the bursa and explore it. The bursa, if distended or inflamed, gives rise to a subdeltoid swelling.

(2) The *upper extremity of the humerus*. Note the small tuberosity in front, the great tuberosity on the outer surface, the bicipital groove between them; these points can be felt through the deltoid muscle.

(3) The *insertions of the subscapularis* (fig. 16 and Plate VI), *supra-spinatus*, *infra-spinatus*, and *teres minor*. These muscles rotate the arm as a whole and retain the head of the humerus in position. The articular surface rests against the glenoid cavity, and the capsule of the joint is only separated by the subdeltoid bursa from the acromion process. In dislocation of the shoulder there is a well-marked gap between the acromion process and the head of the humerus.

(4) The *circumflex nerve and posterior circumflex vessels*. They should be examined as they turn upwards beneath and behind the surgical neck of the humerus. The quadrilateral space, by which they escape, should be cleaned and defined (Plate III).

(5) The *coracoid process* lies beneath the anterior border of the muscle. The process gives insertion to the pectoralis minor, and origin to the short head of the biceps and the coracobrachialis muscle.

The Structures attached to the Coracoid Process.—The student should examine the coracoid process on the scapula which he has by him as he dissects. He will note its fixation to the upper border of the neck of the scapula, and its projection outwards above and in front of the glenoid cavity.

The structures attached to the coracoid process which have now to be examined are (fig. 18 and Plate IV) :—

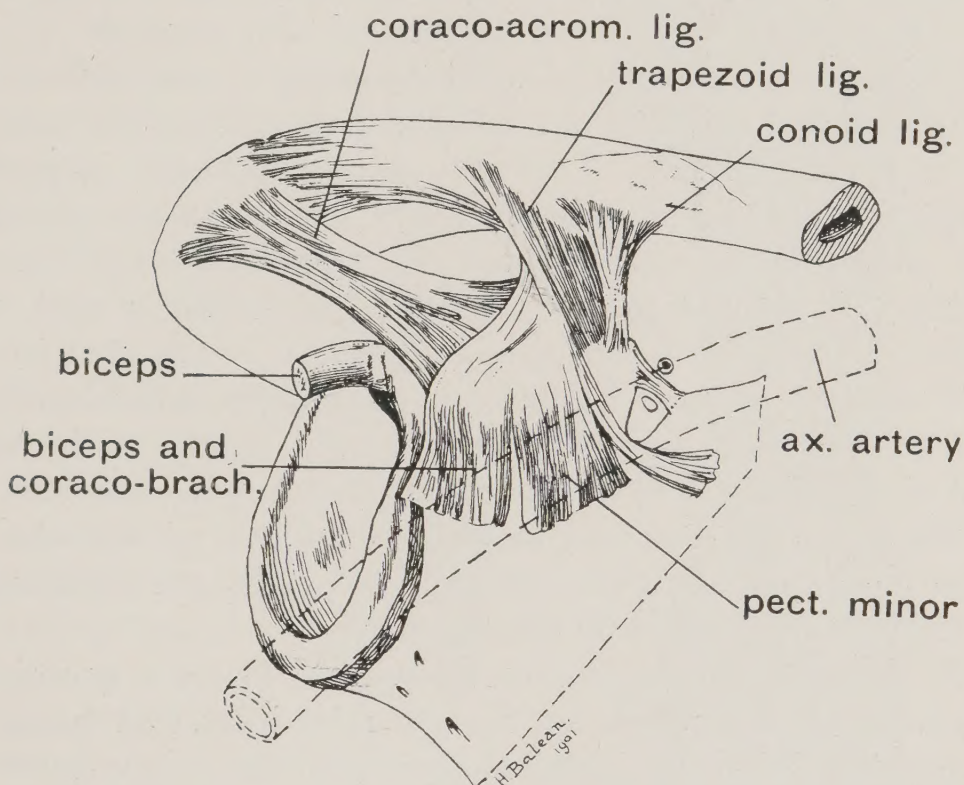
- (1) The pectoralis minor (already dissected).
- (2) The coraco-brachialis muscle (fig. 19).
- (3) The short head of the biceps.

- (4) The coraco-acromial ligament.
- (5) The coraco-clavicular ligaments.
- (6) The coraco-humeral ligament.
- (7) The transverse ligament.

(2) **Coraco-brachialis.**—To see this muscle the axillary artery and accompanying veins and nerves must be pulled away from the neighbourhood of the coracoid process. The branches of the axillary artery should be divided at their origin.

ORIGIN.—From the tip of the coracoid process with the short head of the biceps. The origin is tendinous.

FIG. 18.—SHOWING THE STRUCTURES ATTACHED TO THE CORACOID PROCESS AND POSITION OF AXILLARY ARTERY.



INSERTION.—To a ridge on the inner aspect and just above the middle point of the humerus. The insertion can be better examined during the dissection of the arm ; it lies beneath the brachial artery.

NERVE SUPPLY.—A branch from the outer cord of the brachial plexus. It will be found entering the inner aspect of the muscle. The musculo-cutaneous nerve perforates the coraco-brachialis (fig. 12).

ACTION.—The muscle flexes the arm, bringing it towards the coracoid process.

(3) **Short Head of the Biceps.**—ORIGIN. From the tip of the coracoid process with the last.

INSERTION.—It unites in the arm with the long head to form the belly of the biceps (fig. 19).

(4) The CORACO-ACROMIAL LIGAMENT (fig. 18) is triangular in shape; its apex is attached to the tip of the acromion and outer extremity of the clavicle; its base to the coracoid process. With the acromion and coracoid it forms a resistant arch over the shoulder-joint. The subdeltoid (sub-acromial) bursa separates the arch from the underlying head of the humerus. Its outer edge is continuous with the membranous wall of the bursa.

(5) The CORACO-CLAVICULAR LIGAMENT passes upwards from the angle and upper surface of the coracoid to the under surface of the clavicle. It consists of two parts: the *conoid*, internal and behind; and the *trapezoid*, more external and in front (fig. 18). The two parts sometimes cannot be sharply separated, but a bursa may occur between the two. The trapezoid is attached to the trapezoid ridge of the clavicle; the direction of its fibres is upwards and outwards. The apex of the conoid ligament is attached to the angle of the coracoid, its base to the conoid tubercle of the clavicle. By these ligaments the scapula is bound to the outer third of the clavicle, so that the bones must move together.

The ligaments are very strong; a fracture of the clavicle across their insertion gives rise to no deformity; the fragments are retained in position by the ligaments.

(6) The CORACO-HUMERAL LIGAMENT forms a prominent thickening of the capsule of the shoulder-joint. It passes in the capsule from the coracoid, beneath the coraco-acromial ligament, to the anterior part of the great tuberosity of the humerus (fig. 20). Fibres from the insertion of the pectoralis minor can be traced into it. The ligament strengthens the shoulder-joint.

(7) The TRANSVERSE LIGAMENT crosses the supra-scapular notch from the base of the coracoid to the upper border of the scapula. The supra-scapular artery passes over it; the nerve under it.

Muscles of the Outer and Posterior Walls of the Axilla (fig. 19).—The short head of the biceps and coraco-brachialis formed the narrow outer wall of the axilla; the latissimus

dorsi, teres major, and subscapularis, which formed the posterior wall, are now to be dissected. To see them the origin of the muscles in the outer wall should be detached from the tip of the coracoid process.

Insertion of the Latissimus Dorsi.—Its origin from the lumbar region in the back has been already seen (p. 10). Before the muscle passes beneath the terminal part of the axillary artery, it becomes converted into a flat membranous tendon which is inserted in the floor of the bicipital groove. The teres major is inserted beneath it; a bursa separates their insertions.

NERVE SUPPLY.—The long subscapular nerve enters the muscle above the angle of the scapula.

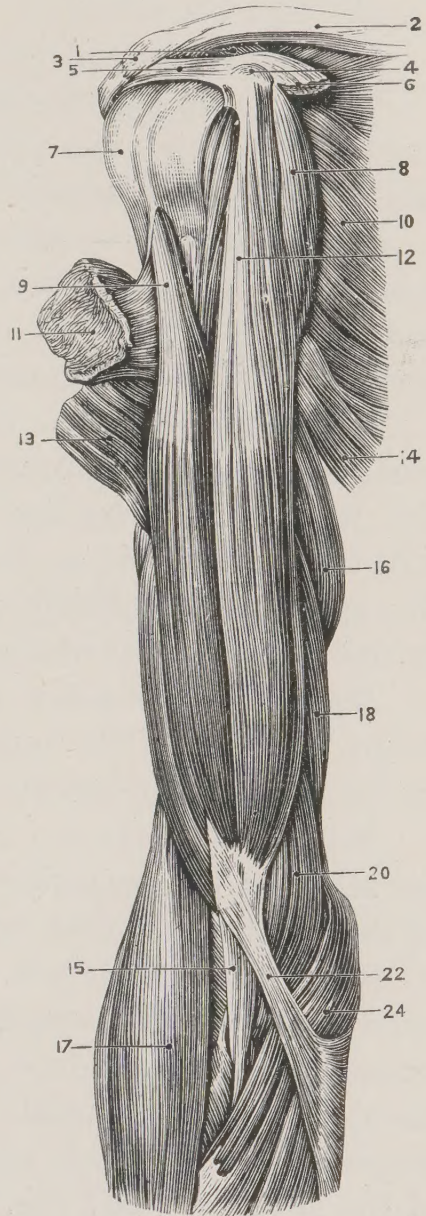
Teres Major.—**ORIGIN.** From an oblong surface on the dorsum of the scapula, above the angle and near the axillary border. Many fibres also arise from the infra-spinal fascia and from the septa which separate it from the teres minor and infra-spinatus.

INSERTION.—To the inner ridge of the bicipital groove, beneath the insertion of the latissimus dorsi (Plate VI).

NERVE SUPPLY.—The lower subscapular nerve.

ACTION.—It brings the arm to the side of the body, retracting it at the same time. The teres major bounds the triangular and quadrilateral spaces externally (fig. 13).

FIG. 19.—FLEXOR MUSCLES OF THE ARM AND FOREARM. (*Bonamy and Beau.*)



1. Coraco-clavicular ligament. 2. Clavicle.
3. Acromio-clavicular ligament. 4. Coracoid process. 5. Coraco-acromial ligament. 6. Pectoralis minor. 7. Head of humerus enclosed in capsule of shoulder-joint. 8. Coraco-brachialis. 9. Long head of triceps. 10. Subscapularis. 11. Pectoralis major (cut). 12. Short head of biceps. 13. Deltoid (cut). 14. Latissimus dorsi and teres major combined. 15. Tendon of biceps. 16. Long head of triceps. 17. Supinator longus. 18. Inner head of triceps. 20. Brachialis anticus. 22. Bicipital fascia. 24. Pronator radii teres.

Vertebral Border of the Scapula.—The student should now *examine* and *remove* the insertions of the following muscles, which he could not clearly define while the scapula was still attached to the body:

- (1) The Serratus Magnus.
- (2) The Rhomboids.
- (3) The Levator Anguli Scapulæ.

He will find that the subscapular muscle, which he should now examine, requires the removal of much connective tissue and fat to display it satisfactorily.

Subscapularis.—ORIGIN (Plate IV). From the ventral surface of the scapula to within two inches of the glenoid cavity, and from the insertion of the serratus magnus. The muscle arises partly by tendinous septa from ridges on the bone.

INSERTION.—To the lesser tuberosity of the humerus and a portion of the shaft immediately below this. A bursa separates the muscle and tendon from the neck of the scapula and root of the coracoid process. This bursa communicates with the synovial membrane of the shoulder by a large opening in the anterior part of the capsule.

ACTION.—It rotates the humerus and arm inwards, and keeps the head of the humerus in apposition with the glenoid cavity during movements of the arm.

NERVE AND BLOOD SUPPLY.—By one or two subscapular nerves from the posterior cord. The muscle receives branches of the subscapular and circumflex vessels.

SUBSCAPULAR BURSA.—The origin of the muscle should be detached from the scapula by the handle of the scalpel and raised until the tendon is seen to blend with the capsule of the shoulder-joint. Beneath its insertion will be found the subscapular bursa, which communicates freely with the interior of the shoulder-joint (fig. 21).

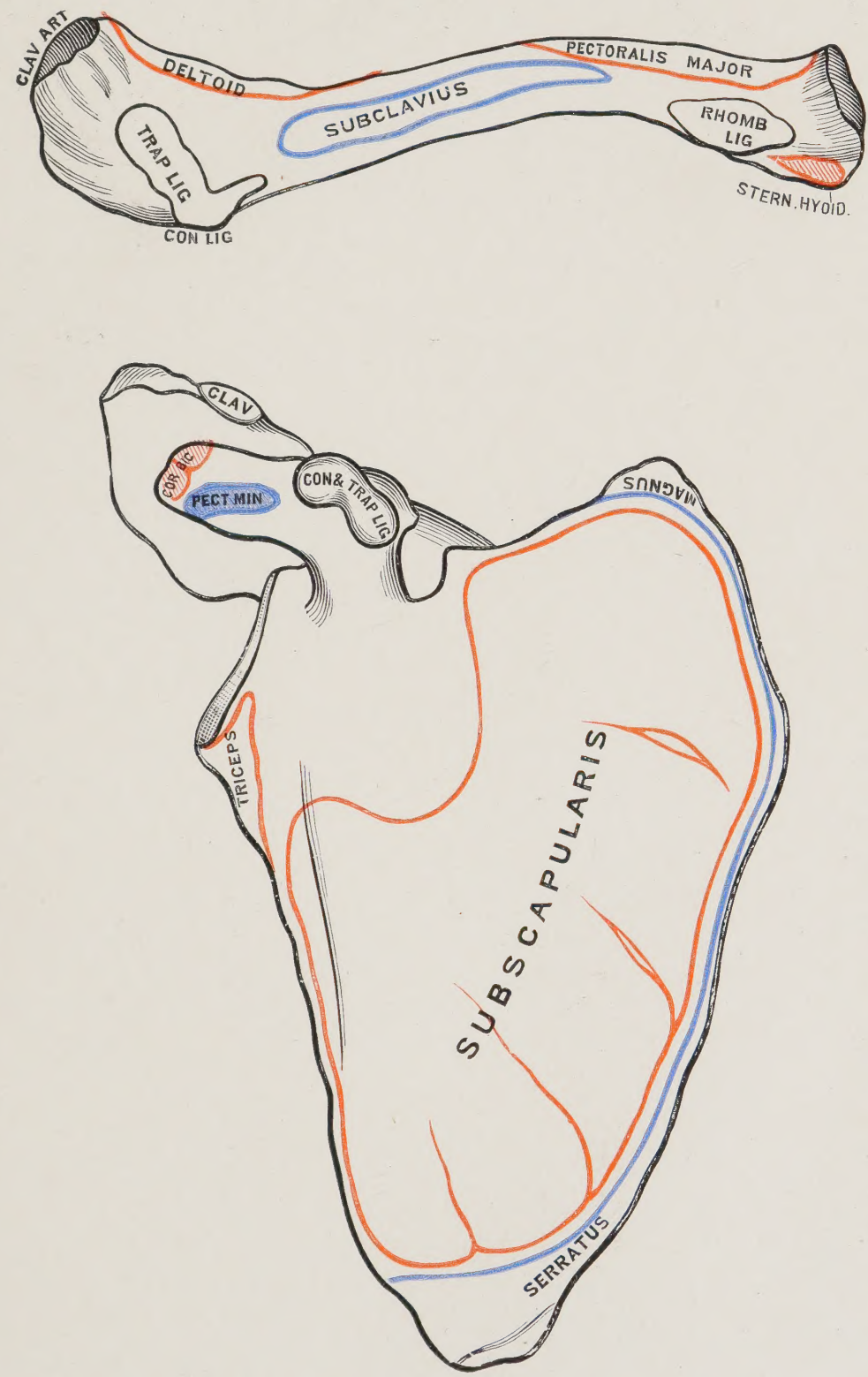
The muscle should now be cut away. Beneath it, branches of the dorsalis scapulæ, supra-scapular and posterior scapular arteries will be found, forming a scapular plexus.

SUPERIOR BORDER OF THE SCAPULA.—The student should here note the following points:

- (1) The *transverse ligament* crossing the supra-scapular notch. It is attached to the inner base of the coracoid (fig. 21).
- (2) The *supra-scapular artery*, a branch of the subclavian,

PLATE IV.

SHOWING THE ATTACHMENT OF MUSCLES TO THE UNDER SURFACE OF THE CLAVICLE AND VENTRAL ASPECT OF THE SCAPULA. (After Holden.)



which passes over the transverse ligament and ends on the dorsum of the scapula.

(3) The *supra-scapular nerve* passes through the notch and supplies the muscles on the dorsum of the scapula.

(4) The insertion of the omo-hyoid to the upper border of the scapula near the notch.

Supra-spinatus.—To see the insertions of the supra-spinatus and infra-spinatus, the acromion process should be sawn through at its base and turned aside.

ORIGIN.—From the supra-spinous fossa, upper surface of the scapular spine, and from the fascia covering the muscle.

INSERTION.—The muscle passes beneath the acromion process and over the shoulder-joint to be inserted into the upper part of the greater tuberosity of the humerus, being closely blended with the capsular ligament.

ACTION.—It retains the articular surface of the shoulder-joint in apposition and helps to raise the arm.

NERVE AND BLOOD SUPPLY.—The muscle should be raised from the supra-spinous fossa and cut away at its insertion. The supra-scapular artery and nerve supply the muscle and pass beneath it to reach the shoulder-joint and infra-spinous fossa.

Infra-spinatus.—**ORIGIN.** From the infra-spinous fossa and under surface of the scapular spine, also from the strong fascia over the muscle and the fascial septum which separates it from the teres minor.

INSERTION.—The muscle passes outwards over the back of the shoulder-joint to be inserted into the middle of the great tuberosity of the humerus, being firmly blended near its insertion with the capsular ligament. Occasionally a small bursa separates the tendon of the muscle from the capsular ligament, and frequently the infra-spinatus and teres minor are inseparable.

ACTION.—It rotates the humerus and arm outwards.

NERVE AND BLOOD SUPPLY.—The muscle should be raised from the infra-spinous fossa, and as it is reflected outwards the supra-scapular nerve and vessels will be found passing between the glenoid cavity and spine of the scapula to end in the deep surface of the muscle. The supra-scapular artery anastomoses with branches of the dorsalis scapulæ and posterior scapular arteries.

Teres Minor.—**ORIGIN.** From the lower part of the infra-spinous fossa, near the axillary border and the fascial septa between it and the infra-spinatus and teres major (fig. 16).

INSERTION.—It extends outwards below the infra-spinatus behind the shoulder-joint, to be inserted into the lower part of the great tuberosity below the infra-spinatus, and extending downwards for nearly an inch on the shaft of the humerus. The tendon, like those of the supra- and infra-spinati and subscapularis, is firmly blended with the capsular ligament.

ACTION.—The muscle rotates the humerus outwards.

NERVE SUPPLY.—A branch of the circumflex nerve, with a fibrous fusiform enlargement, supplies the muscle.

Supra-scapular Artery.—This, a branch of the thyroid axis, is derived from the first part of the subclavian. It passes outwards behind the clavicle and beneath the lower part of the trapezius to reach the upper border of the scapula. The above may be called its *cervical* portion.

It then passes over the supra-scapular ligament into the supra-spinous fossa, between the supra-spinatus and the bone, and finally enters the infra-spinous fossa by passing beneath the acromion across the back of the neck of the scapula, where it is crossed by a transverse fibrous band, the *spino-glenoid ligament*. In the infra-spinous fossa the artery ramifies between the infra-spinatus and the bone, and terminates by anastomosing with the dorsalis scapulæ and twigs from the posterior scapular and subscapular, near the inferior angle of the scapula.

The artery is joined beneath the trapezius by the supra-scapular nerve, which passes beneath the transverse ligament and afterwards follows the artery closely in its distribution.

BRANCHES.—The *cervical* portion gives off branches to the sterno-mastoid, subclavius, nutrient to the clavicle, and a small subscapular branch which passes to the subscapular fossa between the subscapularis and the bone and anastomoses with the twigs of the infra-scapular plexus.

The *scapular* portion gives off branches to the supra-spinatus and infra-spinatus, to the shoulder-joint and the acromion process, and nutrient branches to the scapula in the supra-spinous and infra-spinous fossæ.

Acromio-clavicular Articulation. — The articular bony surfaces on the clavicle and acromion are flat and oblique, the obliquity being such as to allow the clavicle to rest upon the

acromion. The *ligaments* are so arranged as to form a capsule which surrounds the articulation, the capsule being specially thickened superiorly and inferiorly, so as to form a *superior* and *inferior* ligament, of which the superior is by far the stronger and thicker. Dipping into the joint from the deep surface of the superior ligament is a thin plate of fibro-cartilage, or meniscus, which does not, however, form a complete partition in the joint, the synovial membrane being single. This meniscus is frequently so small as to be barely demonstrable. The coraco-acromial ligament supports the outer end of the clavicle.

The *coraco-clavicular* ligaments, by binding the clavicle to the scapula, strengthen indirectly the acromio-clavicular joint. Occasionally the acromion, instead of becoming ossified to the spine of the scapula, is joined to it by a fibrous union. This may be mistaken for a fracture of the process.

Shoulder-joint.—This is a ball-and-socket joint, formed by the articulation of the humeral head with the glenoid cavity.

MUSCLES WHICH SURROUND AND STRENGTHEN THE JOINT.—First examine the relation of the muscles round the joint. The *deltoid* has already been seen covering the joint superficially and forming a muscular hood over it. In more immediate contact with the joint will be found the following muscles, the tendons of which are more or less blended with the capsule.

Above.—Supra-spinatus.

In front.—Subscapularis, usually having a bursa beneath it which communicates with the joint.

Behind.—Infra-spinatus and teres minor. The infra-spinatus is sometimes separated from the capsule by a small bursa communicating with the joint.

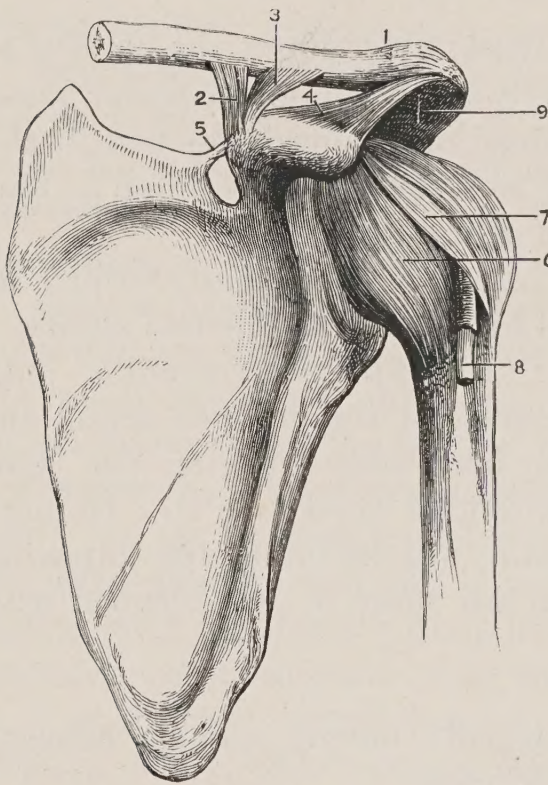
Below.—The long head of the triceps, but not in direct contact with the capsule.

These muscles keep the articular surfaces in contact during the many and complicated movements of the joint. They greatly strengthen the joint. The capsule is least supported below, and it is here that the head of the humerus is thrust through in dislocations of the shoulder-joint. The capsule is lax enough to allow the head of the humerus to be separated half an inch from the glenoid cavity.

The LONG HEAD OF THE BICEPS has a peculiar relation-

ship to the shoulder-joint (fig. 17). It emerges from the articulation and passes down the bicipital groove, where it is surrounded for some distance by a prolongation of the synovial membrane which lines the capsule. The student should run the point of his knife up the bicipital groove and split the capsule of the joint open so as to expose the tendon. He divides at the same time the *transverse fibres* which cross the groove, and the *coraco-humeral ligament* in the capsule (fig. 20).

FIG. 20.—CORACOID LIGAMENTS AND CAPSULE OF THE SHOULDER-JOINT. (Heath.)



1. Superior acromio-clavicular ligament. 2. Coraco-clavicular ligament; this aspect of the ligament is named conoid. 3. Trapezoid portion of the same ligament. 4. Coraco-acromial ligament. 5. Transverse ligament. 6. Capsular ligament. 7. Coraco-humeral ligament. 8. The long tendon of the biceps issuing from the capsular ligament, and entering the bicipital groove. 9. Under surface of acromion.

Certain thickened bands of the capsule will be seen, viz.: coraco-humeral and gleno-humeral.

The *coraco-humeral ligament* lies at the upper part of the capsule, and extends from the root of the coracoid process, obliquely downwards and outwards, over the tendon of the biceps, to the great tuberosity of the humerus (fig. 21).

The *gleno-humeral ligaments* are three bands, one of which, the *superior gleno-humeral ligament* (Flood's ligament), is seen

The tendon lies within the capsule surrounded by synovial membrane. It is attached to the supraglenoid tubercle.

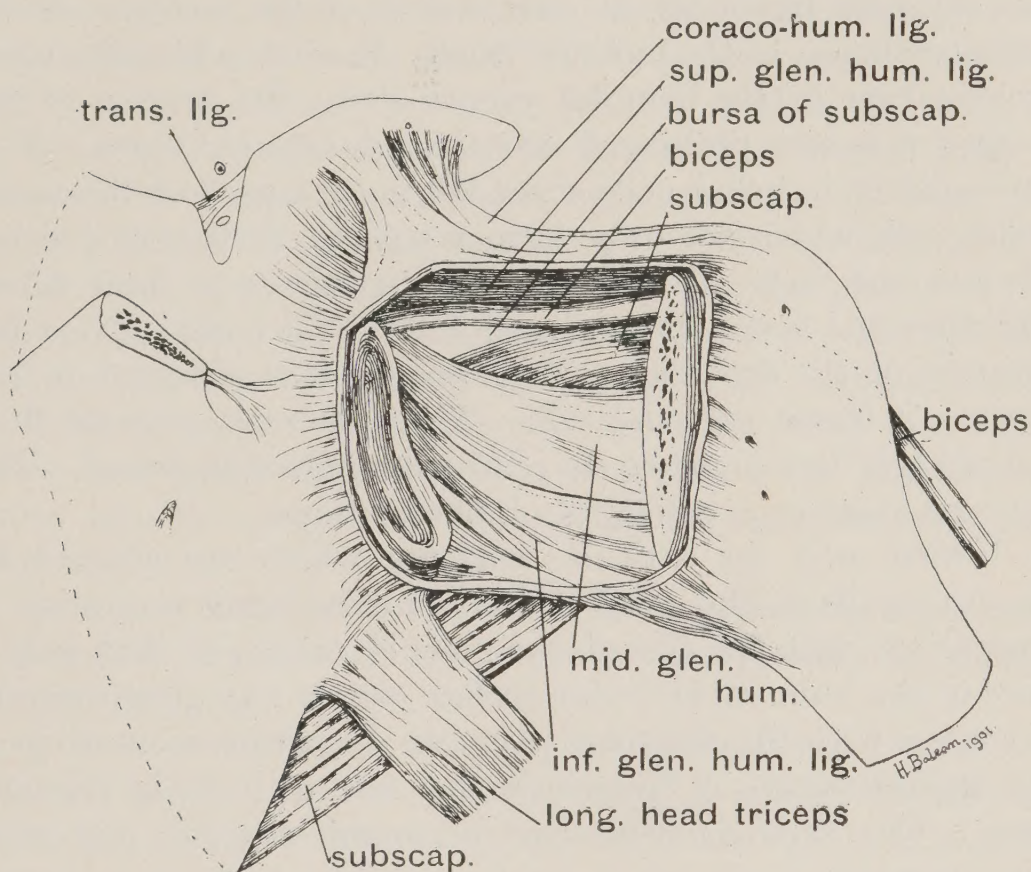
The **Capsular Ligament** is very lax when the muscles are completely dissected away, and allows the extensive separation of the head of the humerus from the glenoid cavity. It permits a wide range of movement at the shoulder.

It is attached above to the scapula, around the glenoid cavity outside, and partly from, the glenoid ligament, extending superiorly to the root of the coracoid process. Its humeral attachment is partly to the anatomical neck and partly to the tuberosities (see fig. 20).

only on the inner surface of the capsule; here it lies immediately in front and internal to the tendon of the biceps (fig. 21). It is well marked in the foetus.

The posterior part of the capsule, comparatively thin now that the infra-spinatus and teres minor are removed, should be cut away so as to expose the interior of the joint. The head of the humerus prevents a full view of the anterior capsule from within. Rotate the humerus inwards so that the head springs from the capsule and saw it off (fig. 21). The wide opening

FIG. 21.—THE INTERIOR OF THE CAPSULE OF THE SHOULDER-JOINT EXPOSED FROM BEHIND.



of the synovial bursa, which lies beneath the subscapularis, is seen; the superior gleno-humeral part of the capsule bounds the opening above; it is bounded below by the oblique fibres of the capsule which form the middle gleno-humeral ligament.

The *inferior gleno-humeral ligament* strengthens the inferior part of the capsule (fig. 21).

The *glenoid ligament* is a band of white fibro-cartilage forming the rim of the glenoid cavity, thus deepening it. Superiorly it is intimately blended with the origin of the long tendon of the biceps.

The Synovial Membrane.—This is the first opportunity the dissector has had so far to examine an extensive synovial membrane and joint. He already saw the smooth synovial lining of the great sub-acromial (subdeltoid) bursa and also that of the sterno-clavicular joint, but it is in connection with the shoulder-joint that he should try to build up a clear conception of what a synovial membrane is. The interior of an articulation is lined with (1) articular cartilage, (2) synovial membrane. In the shoulder-joint the synovial membrane commences at the circumference of the articular cartilage of the glenoid cavity and passes as the lining on the interior of the capsular ligament, to end below at the margin of the articular surface of the humeral head. It sends a funnel-shaped prolongation to the bicipital groove along the tendon of the biceps; it is also prolonged into the subscapular bursa. Flat pavement endothelial cells cover the inner aspect of the membrane, cells which not only form a smooth surface to prevent friction, but have also the power to secrete a fluid which lubricates and keeps the surfaces of the joint moist. Near the margins of the articular surfaces, where it is reflected to the capsule, it forms synovial villi. These secrete synovial fluid and can best be seen when the joint is immersed in water. The synovial membrane is liable to inflammations.

Notice next the articular surfaces which are covered by smooth cartilage, the head of the humerus being very large in comparison with the size of the glenoid cavity, so that only a third of the humeral articular surface can at any given time be in contact with the glenoid cavity. In dissecting-room subjects the shoulder-joint is frequently the seat of chronic rheumatism. The cartilage will then be found irregular and worn away in parts.

Movements of the Shoulder-joint.—**FLEXION, OR MOVEMENT FORWARDS.**—Created by the pectoralis major, coracobrachialis, anterior fibres of the deltoid.

EXTENSION, OR MOVEMENT BACKWARDS.—By the latissimus dorsi, teres major, and the posterior fibres of the deltoid.

ABDUCTION.—By the deltoid and supra-spinatus.

ADDUCTION.—By the pectoralis major, teres major, latissimus dorsi.

ROTATION OUTWARDS.—By the infra-spinatus, teres minor, supra-spinatus.

ROTATION INWARDS.—By the subscapularis, teres major, latissimus dorsi, pectoralis major.

CIRCUMDUCTION is produced by a combination of the action of the above muscles.

DISSECTION VI

THE SUPERFICIAL STRUCTURES OF THE ARM

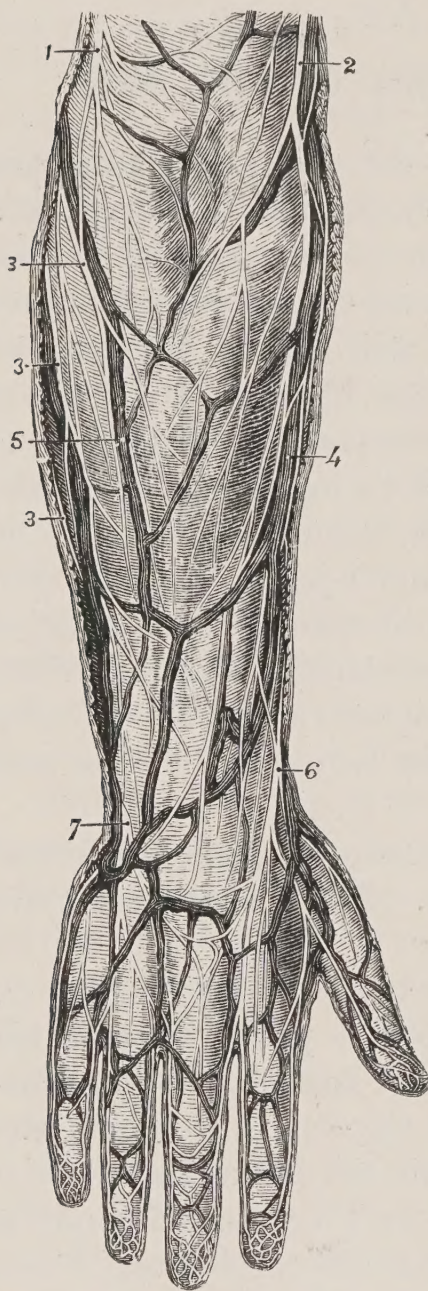
STRUCTURES TO BE EXAMINED.—In this dissection the student has to find and trace out the numerous nerves and veins found in the subcutaneous tissue (superficial fascia) between the shoulder and wrist. The nerves are purely sensory and supply the skin of the arm. He will find in the arm, as in the leg, that although much of the blood of the limb is returned by *venæ comites*, which accompany the arteries, yet a very considerable portion is returned by veins which, in life, he can trace upwards beneath the skin, from the plexus on the back of the hand almost to the shoulder-joint. He will find that the muscles of the arm are bound within compartments of the deep fascia. When the muscles contract the deep veins which accompany the arteries are compressed, the blood being forced into the superficial veins, lying between the skin and deep fascia.

SURFACE MARKINGS.—The student can study the superficial markings at any time in his own arm. At present he should note in his part :

1. The prominence caused by the belly of the biceps.
2. The line of the brachial artery (p. 65) ; it passes downwards at the inner border of the biceps muscle (Plate V).
3. The antecubital space (Plate VII) in front of the elbow, in which the tendon of the biceps can be felt ; within the fossa the brachial artery divides into radial and ulnar.
4. The internal condyle, the prominence at the inner side of the elbow ; behind it the ulnar nerve passes, and when compressed gives rise to a peculiar sensation.
5. The external condyle, on the outer side of the joint.
6. The tip of the olecranon between and in line with the condyles when the arm is extended ; below them when the arm is flexed ; it is rather nearer to the internal condyle. The diagnosis of dislocation of the elbow-joint is made from a recognition of a disturbance in the normal relationship of the

olecranon to the condyles. 7. A depression below the external condyle, in which the head of the radius can be felt rotating when the forearm is pronated and supinated.

FIG. 22.—SUPERFICIAL VEINS AND NERVES ON THE EXTENSOR ASPECT OF THE FOREARM. (*Hirschfeld and Leveillé.*)



1. Posterior branch of internal cutaneous nerve. 2. External cutaneous branch of musculo-spiral nerve. 3, 3. Internal cutaneous nerve. 4. Radial vein and external cutaneous nerve. 5. Posterior ulnar vein. 6. Radial nerve. 7. Dorsal branch of ulnar nerve.

The Superficial Veins of the Upper Extremity.—To expose these veins the student should reflect the skin of the arm and forearm down to the wrist. The opening incision should be carried along the flexor front aspect of the arm from the cut edge of the skin above to the wrist below. A transverse incision carried across the wrist allows the skin to be reflected outwards and inwards in two flaps. The flaps are reflected until the extensor (back) surface of the limb is exposed, but the skin is not to be removed, as it forms a convenient wrapping to keep the part moist.

The superficial veins (Plate VII) are extremely variable in their arrangement; but although no two people possess exactly the same arrangement in detail, yet there is a close resemblance in their general disposition. The student must use his judgment in recognising the variations in his part.

(1) The *superficial dorsal plexus of the hand* (fig. 22) need not now be exposed. It is formed by digital veins from the fingers, and also receives many veins from the palmar surface.

(2) The *superficial palmar plexus* lies beneath the skin of

the palm. The pressure to which the palm is subject prevents the veins of the plexus being of great size.

(3) The *median vein* begins by several small venules from the palmar plexus in front of the wrist (fig. 23). It passes to the anticubital fossa, where it is joined by the *deep median vein*. The median vein then divides into *median-basilic* (the vein from which blood is let) and *median-cephalic* (fig. 23).

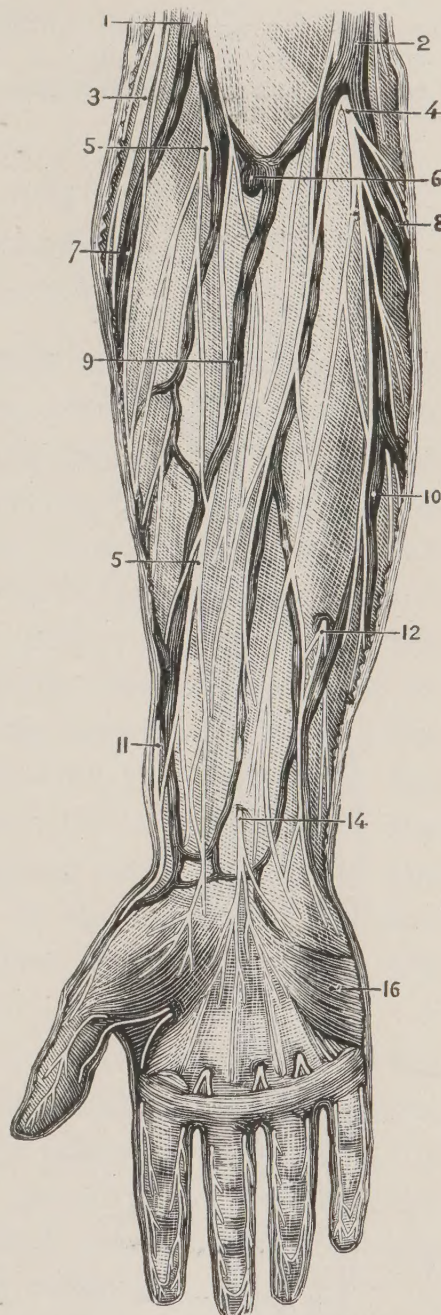
(4) The *radial vein*, composed of several tributaries, begins in the dorsal plexus of the hand, on the radial (thumb) side, and passes to the median-cephalic vein (figs. 22 and 23).

(5) The *anterior* and *posterior ulnar veins* are irregular; they commence in the ulnar part of the dorsal plexus and end in the median-basilic vein (figs. 22, 23 and Plate VII).

(6) The *median-cephalic vein* (fig. 23) passes upwards in the groove between the supinator longus and biceps, and is joined by the radial vein, the *cephalic* being thus formed. The main continuation of the musculocutaneous nerve passes over the median-cephalic vein.

(7) The *median-basilic vein* (fig. 23 and Plate VII) passes obliquely upwards and inwards over the bicipital fascia, which separates it from the lower part of the brachial artery. At this point the operation of phlebotomy is performed, and the student will observe how close to the brachial artery the vein lies. The vein is joined by the two ulnar veins either separately or jointly, the

FIG. 23.—SUPERFICIAL NERVES AND VEINS ON THE FLEXOR ASPECT OF THE FOREARM. (Hirschfeld and Leveillé.)



1. Cephalic vein. 2. Basilic vein. 3. External cutaneous branch of musculo-spiral nerve. 4. Internal cutaneous nerve. 5, 5. External cutaneous nerve. 6. Deep vein joining the bifurcation of the median. 7. Radial vein. 8. Posterior ulnar vein. 9. Median vein, dividing into median-basilic and median-cephalic veins. 10. Anterior ulnar vein. 11. Radial nerve. 12. Cutaneous branch of ulnar nerve. 14. Palmar branch of median nerve. 16. Palmaris brevis muscle.

basilic vein being thus formed. Some branches of the internal cutaneous nerve pass over this vein, while others pass beneath it.

(8) The *cephalic vein* extends upwards from the elbow along the outer border of the biceps, then between the deltoid and pectoralis major (fig. 24). It

FIG. 24.—SHOWING THE SUPERFICIAL VEINS AND LYMPHATICS OF THE ARM AND FOREARM. (Wilson.)



passes underneath the clavicular head of the pectoralis major and, having pierced the costo-coracoid membrane, crosses the axillary artery to enter into the axillary vein. It may be joined to the external jugular by a small vein over the clavicle.

(9) The *basilic vein* (fig. 24) extends upwards on the inner side of the biceps, parallel with but superficial to the brachial artery. Below the middle of the arm it pierces the deep fascia, and, at the lower border of the pectoralis minor, it is joined by the *venæ comites* of the brachial artery to form the axillary vein.

Cutaneous Nerves of the Arm (see figs. 22, 23, 25 and 26).—The following nerves should be sought for:—

A. To the skin on the anterior aspect of the arm (brachium) :

1. Internal cutaneous nerve.
2. Lesser internal cutaneous nerve.
3. The two external cutaneous branches of the musculo-spiral.

B. To the skin on the posterior aspect of the arm :

1. Internal cutaneous branch of the musculo-spiral.
2. Lesser internal cutaneous nerve.
3. The intercosto-humeral.

C. To the skin on the anterior aspect of the forearm :

1. Anterior division of the internal cutaneous.
2. External cutaneous of the musculo-cutaneous.
3. External cutaneous of the musculo-spiral.
4. Palmar branch of the median.
5. Palmar branch of the ulnar.

D. To the posterior aspect of the forearm :

1. External cutaneous branch of the musculo-spiral.
2. Posterior division of the internal cutaneous.
3. Cutaneous branches of the radial.
4. Cutaneous branches of the ulnar.

1. The *internal cutaneous nerve* (figs. 12, 23 and 25) arises from the inner cord of the brachial plexus. It should be looked for as it passes downwards superficial to and on the inner side of the brachial artery. Piercing the deep fascia near the middle of the arm it divides into anterior and posterior divisions above the elbow. The internal cutaneous nerve supplies the skin on the anterior and posterior aspects of the ulnar half of the forearm, its final twigs reaching almost to the wrist. Small twigs leave the main nerve and supply the skin of the anterior and inner aspects of the arm from the insertion of the pectoralis major to the elbow. Note the branches of the posterior division passing over or behind the internal condyle, and the branches of the anterior division crossing the median basilic vein. The main trunk of the nerve lies external to the basilic vein.

2. The *lesser internal cutaneous nerve* (nerve of Wrisberg) is distributed to the skin of the arm internal to the last nerve. It supplies the skin on the inner and posterior aspects of the arm above the elbow (fig. 25). At its origin it is connected with the internal cutaneous nerve, and commonly receives a fasciculus from the intercosto-humeral nerve (fig. 14).

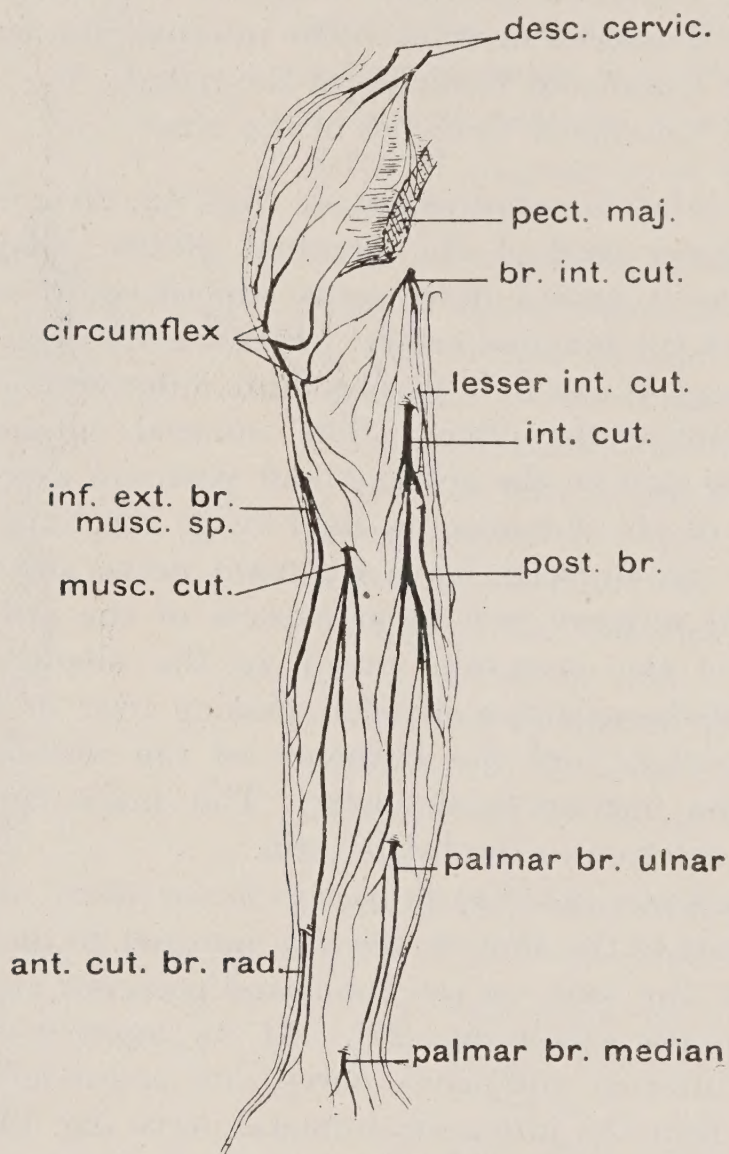
3. The *intercosto-humeral nerve* is distributed to the skin on the posterior aspect of the arm (figs. 12 and 26). It may be accompanied by a second intercosto-humeral nerve, a branch of the third intercostal.

4. The *internal cutaneous branch of the musculo-spiral* (fig. 26) will be found by dissecting out the musculo-spiral nerve as it passes between the heads of the triceps muscle to

enter the musculo-spiral canal. Its internal cutaneous is a small branch which passes over the long head of the triceps to end in the skin of the arm.

5. The *external cutaneous branches of the musculo-spiral nerve* (figs. 16 and 25) issue below and to the outside of the deltoid insertion. The upper branch is small and ends in

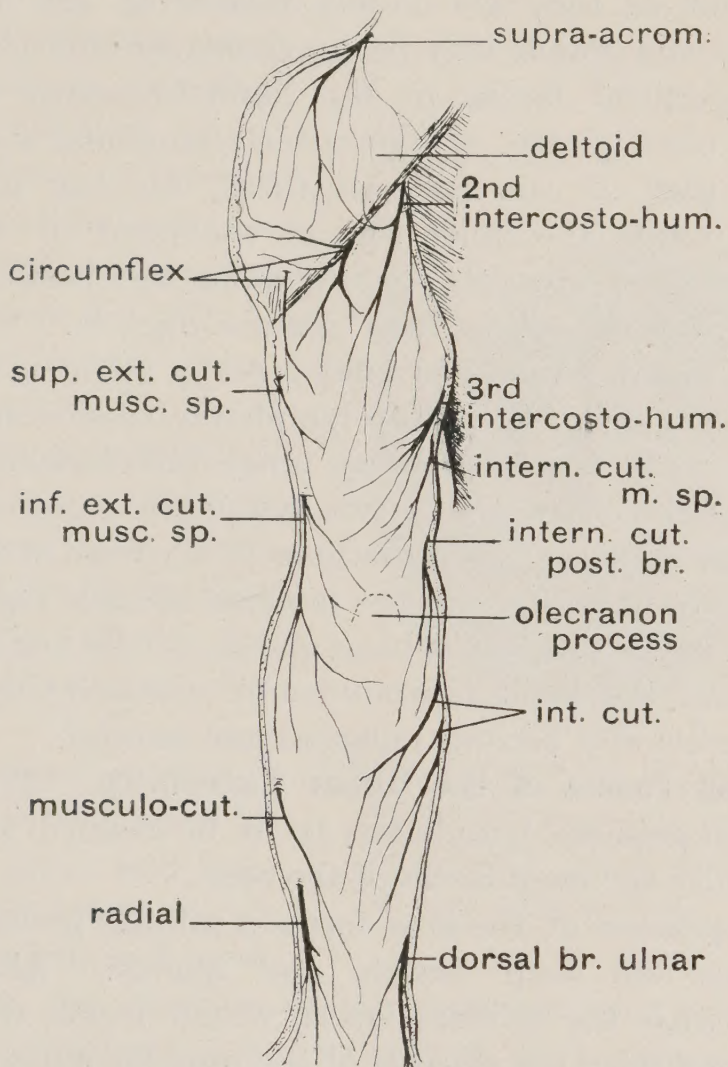
FIG. 25.—SHOWING THE DISTRIBUTION OF THE CUTANEOUS NERVES ON THE FLEXOR ASPECT OF THE ARM AND FOREARM.



the skin below the deltoid insertion. The lower branch (fig. 26) emerges from the external intermuscular septum, half an inch below the upper. It is a large nerve, and supplies the radial aspect of the upper two thirds of the forearm, and also the skin on the outer and posterior aspect of the arm above the elbow.

6. The *external cutaneous nerve* (figs. 23 and 25) is a continuation of the musculo-cutaneous nerve. The musculo-cutaneous nerve has already been seen as it perforates the coraco-brachialis muscle. The external cutaneous nerve should be found in the anticubital fossa as it pierces the deep fascia at the outer side of the biceps and passes beneath or above the

FIG. 26.—SHOWING THE DISTRIBUTION OF CUTANEOUS NERVES ON THE EXTENSOR ASPECT OF THE ARM AND FOREARM.



median cephalic vein. Branches can be traced as far as the ball of the thumb.

7. The *palmar branch of the ulnar* (fig. 23) appears in the superficial fascia two or three inches above the wrist. It ends in the skin of the palm.

8. The *palmar branch of the median* (fig. 23) appears about one inch above the wrist. It is a small twig, and ends in the skin of the palm.

9. The *dorsal branch of the ulnar* (fig. 22) passes to the dorsum of the hand below the lower extremity of the ulna. The terminal branches will be traced later.

10. The *radial nerve* (fig. 22) will be found passing to the back of the hand on the dorsal surface of the lower extremity of the radius. It also will be traced in detail at a later stage.

Lymphatics of the Upper Extremity (fig. 24).—In the absence of special preparation, only a few of these can be dissected, but as they are closely related to the veins, the main vessels and glands may be conveniently referred to here.

The superficial fascia of the hand, forearm, and arm contains a close plexus of *superficial* lymphatic vessels. In the upper part of the forearm these, for the most part, converge towards the inner side of the bend of the elbow, whence they pass upwards, mainly along the basilic vein, to join the central set of axillary glands (fig. 8). Some pass along the cephalic vein and may enter a gland in the infra-clavicular fossa (fig. 24). Deep lymphatic vessels accompany the arteries: the brachial, radial, ulnar, interosseous, &c. In the region of the elbow one or two lymphatic glands are found in the superficial fascia, one sometimes in the bend of the elbow, and one or two usually above the internal condyle (epitrochlear glands) (fig. 24). The epitrochlear glands are the first to become enlarged when the hand is wounded or diseased; the central set of the axilla also become enlarged and painful.

The Deep Fascia of the Upper Extremity.—The nerves, veins, and superficial lymphatics are to be cleaned away so as to expose fully the deep fascia of the arm.

The deep fascia of the arm forms a tubular investment for the muscles and deep vessels and nerves. Above it is continuous with the axillary fascia, which forms the floor of the axilla, and with the sheaths of the muscles which surround the shoulder and form the walls of the axilla. In the region of the elbow it is attached to the subcutaneous surfaces of bone and then extends to the forearm, where it also invests the muscles and is firmly attached to the posterior border of the ulna. At the wrist it is specially thickened and modified to form annular ligaments which bind down the flexor and extensor tendons.

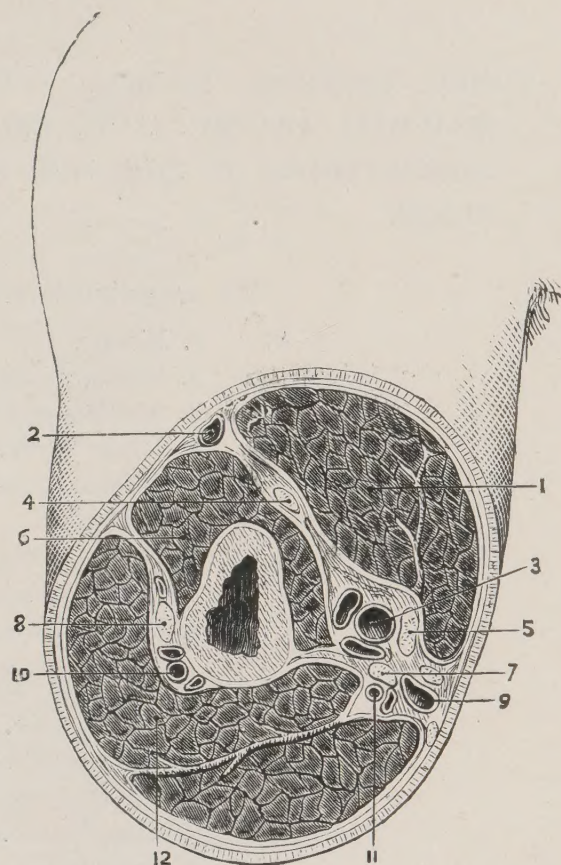
Intermuscular Septa.—In the lower half of the upper arm the deep fascia gives off on its deep surface two processes

or partitions of fascia. These are the *external* and *internal intermuscular* septa, which are attached respectively to the external and internal supra-condyloid ridges, and thus divide this part of the arm into two compartments, anterior and posterior (fig. 27). The anterior compartment contains the biceps, brachialis anticus, supinator longus and extensor carpi radialis longior, together with the brachial artery and structures in relation to it, while the posterior compartment contains the triceps muscle (fig. 27).

The *external intermuscular septum* is pierced by the musculo-spiral nerve and superior profunda artery, which pass downwards and forwards from the posterior to the anterior compartment (fig. 16).

The *internal intermuscular septum* is pierced by the ulnar nerve and inferior profunda artery, which pass downwards and backwards from the anterior to the posterior compartment. It is also pierced inferiorly by branches of the anastomotic artery.

FIG. 27.—A SECTION OF THE ARM SHOWING THE INTERMUSCULAR SEPTA. (Heath.)



1. Biceps. 2. Cephalic vein. 3. Brachial vessels. 4. Musculo-cutaneous nerve. 5. Median nerve. 6. Brachialis anticus. 7. Ulnar nerve piercing the internal intermuscular septum. 8. Musculo-spiral nerve piercing the external intermuscular septum. 9. Basilic vein with internal cutaneous nerve. 10. Superior profunda vessels. 11. Inferior profunda vessels. 12. Triceps with fibrous intersection.

DISSECTION VII

THE DEEP STRUCTURES OF THE ARM

Deep Brachial Veins.—Before proceeding to examine the brachial artery, the student should examine the venæ comites which lie on each side of it, and by numerous com-

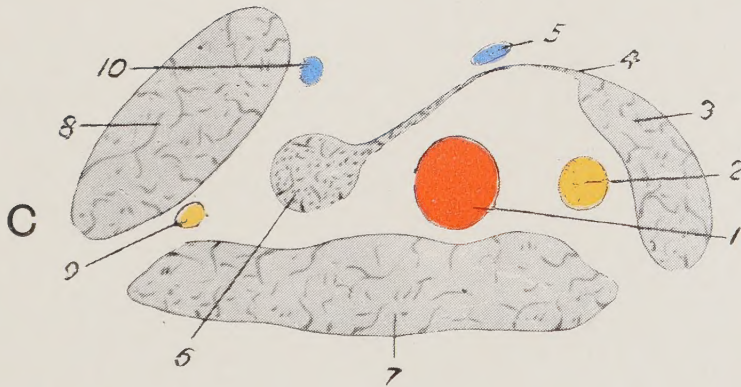
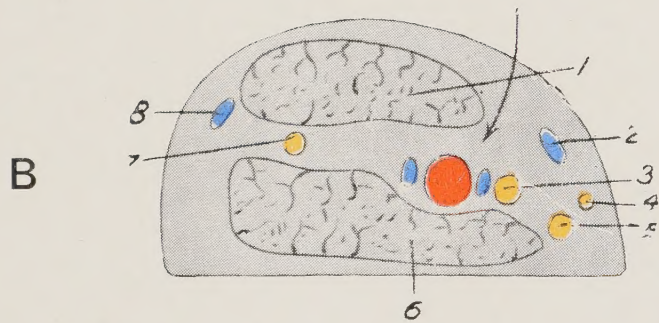
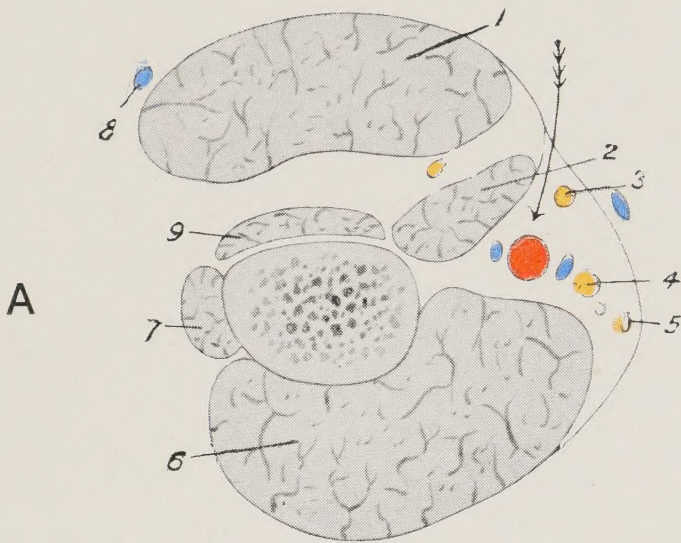
PLATE V.

THREE SECTIONS SHOWING THE RELATIONSHIP OF THE BRACHIAL ARTERY: (A) IN THE MIDDLE THIRD, (B) IN THE LOWER THIRD OF THE ARM, AND (C) IN THE ANTICUBITAL SPACE.

The arrow indicates the brachial artery.

- A.
 - 1. Biceps.
 - 2. Coraco-brachialis.
 - 3. Median nerve.
 - 4. Ulnar nerve.
 - 5. Internal cutaneous.
 - 6. Triceps.
 - 7. External head of triceps.
 - 8. Cephalic vein.
 - 9. Brachialis anticus.
- B.
 - 1. Biceps.
 - 2. Basilic vein.
 - 3. Median nerve.
 - 4. Internal cutaneous.
 - 5. Ulnar nerve.
 - 6. Brachialis anticus.
 - 7. Musculo-cutaneous nerve.
 - 8. Cephalic vein.
- C.
 - 1. Brachial artery.
 - 2. Median nerve.
 - 3. Pronator radii teres.
 - 4. Bicipital aponeurosis.
 - 5. Median basilic vein.
 - 6. Tendon of biceps.
 - 7. Brachialis anticus.
 - 8. Supinator longus.
 - 9. Musculo-spiral nerve.
 - 10. Median-cephalic vein.

PLATE V.



municating twigs form a plexus round the artery (Plate V). The venæ comites of the brachial artery are formed in the anticubital fossa by the union of the veins (venæ comites) which accompany the arteries of the forearm.

The *deep median* vein (Plate VII) pierces the deep fascia of the anticubital fossa, and forms a communication between the deep and superficial veins.

The venæ comites of the brachial artery unite with the basilic vein to form the axillary vein at the lower border of the pectoralis minor.

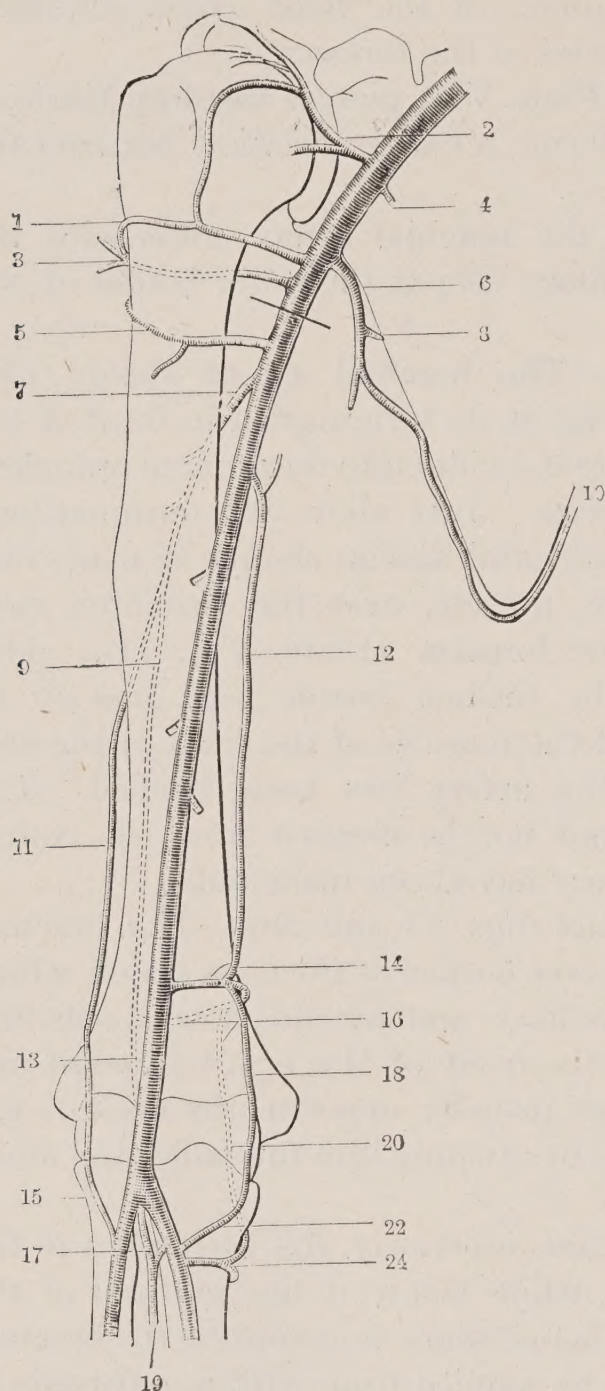
The Brachial Artery.—The brachial artery should now be exposed and cleaned as far as its termination in front of the elbow (see Plate VII). There it divides into its terminal branches, the radial and ulnar arteries. Just above its termination a strong layer of fascia (the bicipital fascia) should be made out, extending from the biceps muscle, over the pronator radii teres, to the fascia of the forearm (Plate VII, H). This should be preserved. The median basilic vein lies on its surface. The dissection of the muscles of the front of the arm can be completed after the artery has been studied. The branches of the artery need not be cleaned until the course and relationship of the artery have been made out.

COURSE OF THE ARTERY (figs. 13 and 28).—The brachial artery commences at the lower border of the teres major, where it is continuous with the axillary, and extends downwards first on the inner side, then on the front of the arm to a point just below the bend of the elbow (usually opposite the neck of the radius), where it terminates by dividing into the radial and ulnar arteries.

It should be noticed that superiorly the artery lies to the inner side of the humerus, while below it lies in front of the bone (fig. 28). Hence, if it is necessary to compress the brachial artery, the pressure must be applied from within, outwards in the upper part, and from before backwards in the lower part.

RELATIONS (fig. 27 and Plate V).—*Superficially*, the artery in the greater part of its extent is covered merely by the skin and fasciæ. It is overlapped by the inner edge of the biceps muscle. About its middle it is crossed from without inwards by the median nerve (excepting in those cases in which the nerve crosses underneath the artery), and near its termination the

FIG. 28.—DIAGRAM SHOWING THE RELATIONSHIP OF THE BRACHIAL ARTERY TO THE HUMERUS, ITS BRANCHES AND THEIR ANASTOMOSES. (Anderson.)



1. Anterior circumflex. 2. Acromio-thoracic. 3. Posterior circumflex. 4. Long thoracic. 5. Superior radial collateral (excessively large). 6. Subscapular. 7. Superior profunda. 8. Dorsalis scapulae. 9. External posterior articular branch of superior profunda. 10. Posterior scapular. 11. External anterior articular branch of superior profunda. 12. Inferior profunda. 13. Posterior interosseous recurrent. 14. Anastomotica magna. 15. Radial recurrent. 16. Transverse branch of anastomotica magna. 17. Posterior interosseous recurrent. 18. Anastomosis of anterior ulnar recurrent with anastomotica. 19. Posterior interosseous from common interosseous of ulnar. 20. Anastomosis of posterior ulnar recurrent with anastomotica. 22. Anterior ulnar recurrent. 24. Posterior ulnar recurrent.

median basilic vein crosses inwards over the artery, the bicipital fascia intervening between them.

Posteriorly, it lies first in front of the long head of the triceps, the musculo-spiral nerve, the superior profunda artery intervening. Then successively on the following structures: the inner head of the triceps, insertion of coracobrachialis, brachialis anticus.

Outer Side.—Coracobrachialis, biceps, and, in the upper half of the arm, the median nerve. At the bend of the elbow the tendon of the biceps is to its outer side.

Inner Side.—In the upper part the ulnar and internal cutaneous nerves lie close to the inner side of the artery. In the lower half these nerves have left the artery (the ulnar to pass backwards through the intermuscular septum, towards the back of the internal condyle, the internal cutaneous to become cutaneous by piercing the deep fascia). The median nerve is internal to the artery in

its lower part and the basilic vein lies on its inner and superficial aspect, but separated from it by the deep fascia.

BRANCHES (fig. 28 and Plate II).—The following branches are to be sought for and carefully cleaned from their origin to their distribution :

- | | |
|-----------------------|------------------------|
| 1. Superior profunda. | 3. Nutrient. |
| 2. Inferior profunda. | 4. Anastomotica magna. |
| 5. Muscular. | |

1. The *Superior profunda artery* is given off close to the origin of the brachial and passes downwards and backwards with the musculo-spiral nerve between the outer and inner heads of the triceps in the musculo-spiral groove. It winds with the nerve round the humerus, and, having reached the outer side of the arm, divides into *anterior* and *posterior* branches (fig. 28). The *anterior* branch pierces the external inter-muscular septum with the musculo-spiral nerve and reaches the interval between the supinator longus and brachialis anticus in which it passes to the elbow, where it anastomoses with the radial recurrent artery. The *posterior* branch is continued downwards on the posterior surface of the external inter-muscular septum to the back of the external condyle, where it anastomoses with the posterior interosseous recurrent artery. Both branches assist to form the *peri-articular plexus* of the elbow-joint (fig. 29).

The superior profunda supplies branches to the triceps, a cutaneous branch to the outer side of the arm, occasionally a nutrient artery to the humerus and an *ascending branch* to anastomose with one or more descending branches of the posterior circumflex artery. These branches are usually found between the outer and inner heads of the triceps, and form connections between branches of the axillary and brachial arteries, through which the circulation can be carried on after ligature of the terminal part of the axillary artery. An enlargement of the ascending branch may give partial or entire origin to the posterior circumflex artery.

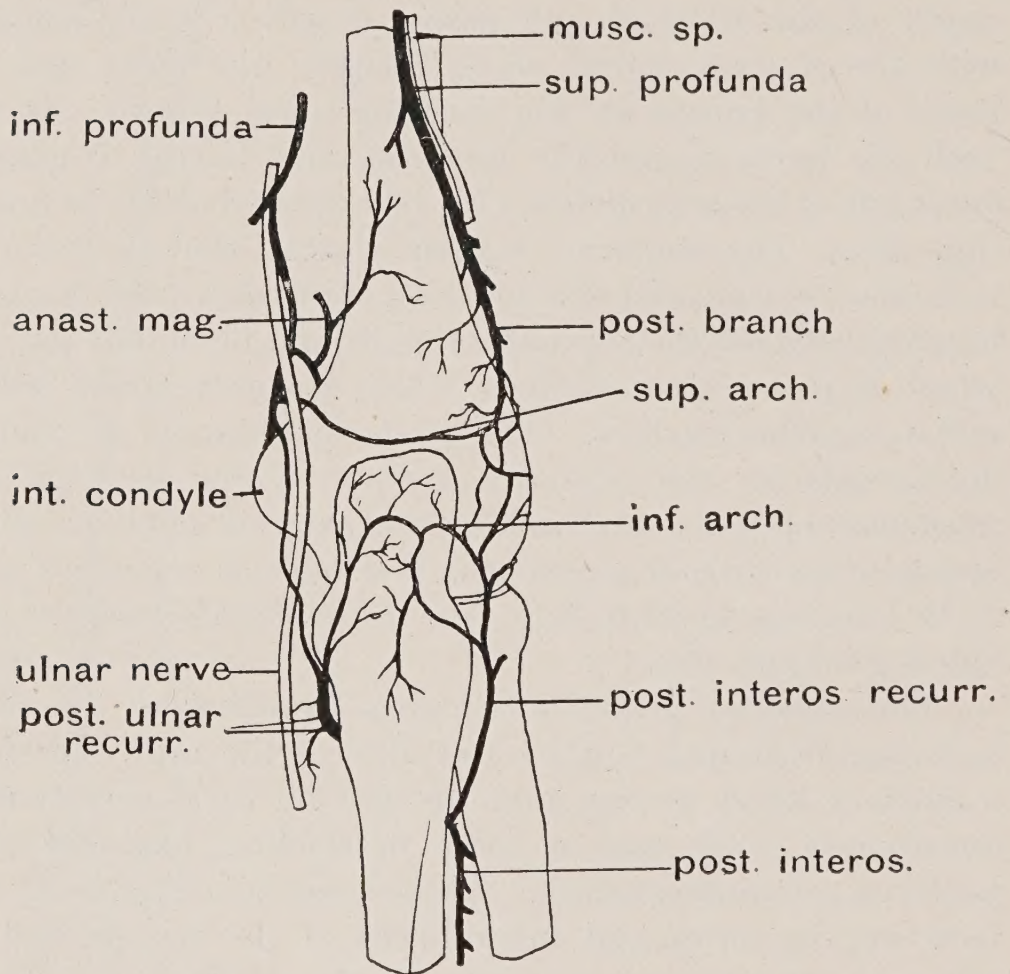
2. The *Inferior profunda artery* may arise in common with the superior profunda. It passes downwards with the ulnar nerve, which will guide the student to it, through the internal intermuscular septum towards the back of the internal condyle. There it anastomoses with the posterior ulnar recurrent and

anastomotic arteries, entering into the formation of the peri-articular plexus of the elbow-joint.

3. The *nutrient artery* is given off opposite the insertion of the coraco-brachialis, and enters a foramen in the humerus, where it divides into a descending and an ascending branch, which ramify in the bone.

It must not be thought that the nutrient is the only artery to the humerus. It is the largest of the arteries which supply

FIG. 29.—THE ARTERIAL PLEXUS ROUND THE ELBOW-JOINT. (After Quain.)



the marrow of the humerus. Numerous small ones enter the bone, especially at its extremities. Numerous arteries will be found to ramify in and supply the *periosteum* of the bone if the part has been successfully injected.

4. The *Anastomotica magna* arises from the inner side of the artery, about a couple of inches above its termination. It divides into two branches. The *anterior branch* passes down in front of the internal condyle to anastomose with the anterior ulnar recurrent, beneath the pronator radii teres. The *posterior*

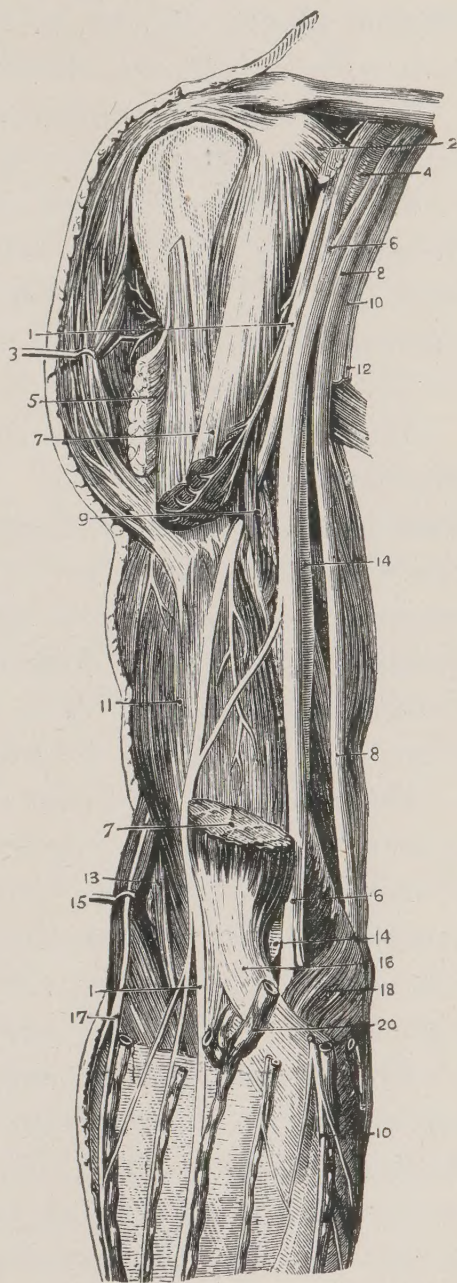
branch pierces the internal intermuscular septum, and, having anastomosed behind this with the inferior profunda artery, is continued transversely across the back of the lower end of the humerus, above the olecranon fossa, and beneath the triceps to anastomose with the superior profunda artery, thus helping to form the peri-articular plexus (fig. 29).

5. The *muscular* branches come off irregularly and supply the flexor muscles of the arm.

The Vas Aberrans.—This artery is frequently present; it varies much in size and in origin. It usually springs from the axillary artery, or occasionally from the upper part of the brachial, and passes down the arm *superficial to the median nerve*. It may end in the arm, if small, but commonly it joins the radial artery at the elbow, and may give rise to that artery. The brachial artery then appears to divide high up in the arm, but the real brachial artery will be seen deep to the median nerve. It is not uncommon for the vas aberrans to give rise to both radial and ulnar, thus replacing the real brachial artery.

Deep Nerves of the Arm.—The cutaneous nerves of the arm have already been examined (p. 58). The student is now to turn his attention to four great nerve-trunks which pass down the arm beneath the deep fascia. These four trunks are (figs. 16 and 30) :—

FIG. 30.—THE DEEP NERVES OF THE ARM. (*Hirschfeld and Leveillé.*)



- 1, 1. Musculo-cutaneous nerve. 2. Pectoralis minor. 3. Deltoid. 4. Axillary artery. 5. Tendon of pectoralis major. 6, 6. Median nerve. 7, 7. Biceps. 8, 8. Ulnar nerve. 9. Coraco-brachialis. 10, 10. Internal cutaneous nerve. 11. Brachialis anticus. 12. Nerve of Wrisberg. 13. Musculo-spiral nerve. 14, 14. Brachial artery. 15. Supinator longus. 16. Bicipital fascia. 17. Inferior external cutaneous branch of musculo-spiral nerve. 18. Pronator radii teres. 20. Median basilic vein.

1. The *ulnar*, one of the main terminal parts of the inner cord of the brachial plexus. It will be found to the inner side of the brachial artery. Its termination is in the forearm and hand.

2. The *median*, formed from the outer and inner cords of the brachial plexus (fig. 14, p. 34). It crosses the brachial artery from without inwards near the middle of the arm.

3. The *musculo-cutaneous*, from the outer cord, perforates the coraco-brachialis and ends as the external cutaneous nerve.

4. The *musculo-spiral* (fig. 16), the onward continuation of the posterior cord. It will be found behind the commencement of the brachial artery. The superior profunda artery accompanies it.

These nerves are now to be examined in detail.

The **Ulnar Nerve** was seen in the axilla lying on the inner side of the axillary artery. It is continued downwards on the inner side of the brachial artery as far as the middle of the arm, where it leaves the artery to pass obliquely backwards with the inferior profunda artery through the internal intermuscular septum. It extends downwards behind the internal condyle, which presents a groove in which the nerve rests. There the nerve is bound down by fibrous tissue.

Between the internal condyle of the humerus and the olecranon process, it enters the forearm between the two heads of origin of the flexor carpi ulnaris lying against the internal lateral ligament. The ulnar nerve gives off no branches until it reaches the elbow, where two or three articular twigs pass from the nerve into the joint.

The **Median Nerve** has been already seen arising in the axilla by two heads from the outer and inner cords of the brachial plexus. The inner head crosses the lower part of the axillary artery, the trunk being thus formed on the outer side of that vessel. The nerve passes down the arm vertically, just under the edge of the biceps muscle to the elbow, where it traverses the anticubital fossa. In the forearm it passes between the two heads of the pronator radii teres. In the upper half of the arm it is external to the brachial artery, but about the middle of the arm it crosses that artery superficially (sometimes beneath) to gain its inner side, along which it passes to the front of the elbow.

The median is frequently connected with the musculo-cutaneous nerve by a fasciculus underneath the biceps.

The median nerve gives off no branches until it reaches the elbow. Here it supplies two or three twigs to the joint, and a branch to the pronator radii teres.

The **Musculo-cutaneous Nerve** (fig. 30), a terminal branch of the outer cord of the brachial plexus, dips into the coracobrachialis, which it perforates obliquely.

Having emerged from this muscle, it extends downwards obliquely between the biceps and brachialis anticus, and appears above the elbow on the outer side of the tendon of the biceps. Having become superficial, it enters the forearm by passing beneath the median cephalic vein and, having divided into two branches, it extends downwards, supplying the skin of the outer side of the forearm, and terminates in the skin over the ball of the thumb.

BRANCHES.—In addition to an occasional communicating branch to the median nerve, the musculo-cutaneous supplies branches to the muscles of the front of the arm, viz. coracobrachialis, biceps, and brachialis anticus.

The branch to the coracobrachialis is given off as the nerve leaves the outer cord of the brachial plexus. Separate branches are given to the two heads of the biceps, the branches to the biceps and brachialis anticus being given off as the nerve lies between the two muscles.

Musculo-spiral Nerve (fig. 16).—The musculo-spiral nerve and triceps muscle should next be dissected. The cutaneous branches of the nerve (one internal and two external) have already been dissected with the superficial fascia (figs. 25 and 26).

The first part of the nerve should be cleaned as it lies behind the upper part of the brachial artery. The third part of the nerve will be found above the elbow by separating the supinator longus from the brachialis anticus.

The intermediate portion (second stage) should also be examined. For this purpose the long, inner and outer heads of the triceps muscle must be separated and cleaned.

The nerve rests on the shaft of the humerus; the three heads of the triceps enclose a canal in which the nerve lies.

There are two points which the student should observe now in connection with the position of the nerve: (1) that it lies close to the shaft of the humerus, and therefore may be injured in fractures of that bone; (2) that in its upper part it is exposed to pressure between the shaft of the humerus and the crutch

used by the lame. Paralysis so caused is known as 'crutch paralysis.'

THREE STAGES IN THE COURSE OF THE MUSCULO-SPIRAL NERVE IN THE ARM.—The musculo-spiral nerve is continued downwards from the posterior cord of the brachial plexus behind the axillary artery and upper part of the brachial artery. It is joined by the superior profunda artery. These two structures lie between the brachial artery and the long head of the triceps muscle. This forms the *first stage* of the nerve.

In its *second stage* it enters the musculo-spiral groove of the humerus, where it lies between the outer and inner heads of the triceps, and, having reached the outer side of the arm, it pierces the external intermuscular septum and enters upon its final or *third stage*, in which it lies between the supinator longus and brachialis anticus muscles (fig. 16). It extends down to a point in front of the external condyle, where it divides into its two terminal branches, *radial* and *posterior interosseus*.

BRANCHES.—*First stage*.—(a) Internal cutaneous branch, already examined (fig. 26).

(b) Branches to the long and inner heads of the triceps. The former is given off in the lower part of the axilla. One of the branches to the inner head runs by the side of the ulnar nerve, and hence has been named the 'ulnar collateral.'

Second stage.—(c) Branches to the *outer* and *inner heads* of the triceps and to the anconeus. To see these, divide the external head of the triceps so as to expose the canal in which the nerve lies. The parts can be replaced when the student comes to study the muscle.

(d) The nerve to the *anconeus* is a long slender twig which extends down to its muscle through the fibres of the inner head of the triceps.

Third stage.—(e) When leaving the musculo-spiral groove it gives off the *external cutaneous* branches (upper and lower). These have been examined (fig. 16).

(f) Branches to the brachialis anticus (also supplied from the musculo-cutaneous), supinator longus, and extensor carpi radialis longior.

The Muscles of the Arm.—The four muscles of the arm, the coraco-brachialis, the biceps, brachialis anticus, and triceps,

have now to be defined and carefully cleaned from origin to insertion.

1. The *coraco-brachialis* (fig. 19) has already been examined (p. 45). Its origin was detached from the coracoid process at an earlier stage; its insertion should now be detached from the impression on the inner aspect of the shaft of the humerus and from the internal intermuscular septum.

2. **Biceps Flexor Cubiti.**—ORIGIN. The *origin* of the *short head* has already been detached from the coracoid process. The *long head* was seen to emerge from the shoulder-joint by the bicipital groove. The origin of this tendon from the supraglenoid tubercle and from the glenoid ligament has already been noted. The student should observe how the intra-articular segment of the tendon serves to retain the head of the humerus and the glenoid cavity of the scapula in apposition during movements of the shoulder-joint.

The two heads terminate in fleshy bellies, which are applied closely to each other in the middle third of the arm. In the lower third they unite and form a strong tendon, which commences as a septum between the bellies. The tendon, when traced downwards, becomes flattened and twisted on itself, so that its outer border becomes anterior.

INSERTION.—The tendon dips deeply into the anticubital fossa to be inserted into the posterior rough part of the bicipital tuberosity of the radius. A bursa is interposed between the tendon and the anterior part of the tuberosity. From the inner border of the tendon, just above the elbow, a firm process of fascia, the *semilunar* or *bicipital fascia*, extends across the lower part of the brachial artery to the fascia of the forearm over the pronator radii teres (Plate VII). On the surface of the bicipital fascia the median-basilic vein passes inwards.

NERVE SUPPLY.—From the musculo-cutaneous nerve.

ACTION.—(1) It flexes the elbow; (2) it raises and adducts the arm at the shoulder-joint; (3) if the forearm is pronated (in position of palm downwards) it acts as a supinator. This action can be more fully studied afterwards.

3. **Brachialis Anticus.**—ORIGIN (Plate VI). From (1) the anterior surface of the humerus as high as the insertion of the deltoid, which it embraces by two pointed processes; (2) the internal intermuscular septum; (3) a small upper part of the external intermuscular septum.

INSERTION.—By a strong tendon to the lower part of the anterior surface of the coronoid process of the ulna (Plate VIII).

NERVE SUPPLY.—From the musculo-cutaneous and musculo-spiral nerves.

ACTION.—It is purely a flexor of the elbow-joint.

4. Triceps (fig. 31).—**ORIGIN** (Plate VI). By three heads:

(a) The *long head* by a strong flattened tendon from a rough surface on the axillary border of the scapula, just below the glenoid cavity of the scapula. (b) The *outer head* from the back of the humerus external to the musculo-spiral groove, extending as high as the insertion of the teres minor, also from the upper part of the external inter-muscular septum. (c) The *inner head* from the posterior surface of the humerus, below the musculo-spiral groove, extending downwards almost to the olecranon fossa, and upwards by a pointed process as far as the insertion of the teres major, from the internal and external inter-muscular septa.

FIG. 31.—THE THREE HEADS OF THE TRICEPS. (Wilson.)



1. External head. 2 Long or scapular head. 3. Internal or short head. 4. Olecranon process of ulna. 5. Radius. 6. Capsular ligament of the shoulder-joint.

INSERTION.—By a strong tendon to the summit and sides of the olecranon process, and by a firm aponeurosis which passes down over the anconeus to the fascia of the forearm. This fibrous expansion strengthens the elbow-joint posteriorly. A small bursa is frequently interposed between the insertion of

the tendon and the tip of the olecranon and posterior ligament.

A few deep fibres of the inner head, which are inserted into the capsular ligament of the elbow-joint, constitute the *sub-anconeus muscle*.

NERVE SUPPLY.—Branches of the musculo-spiral.

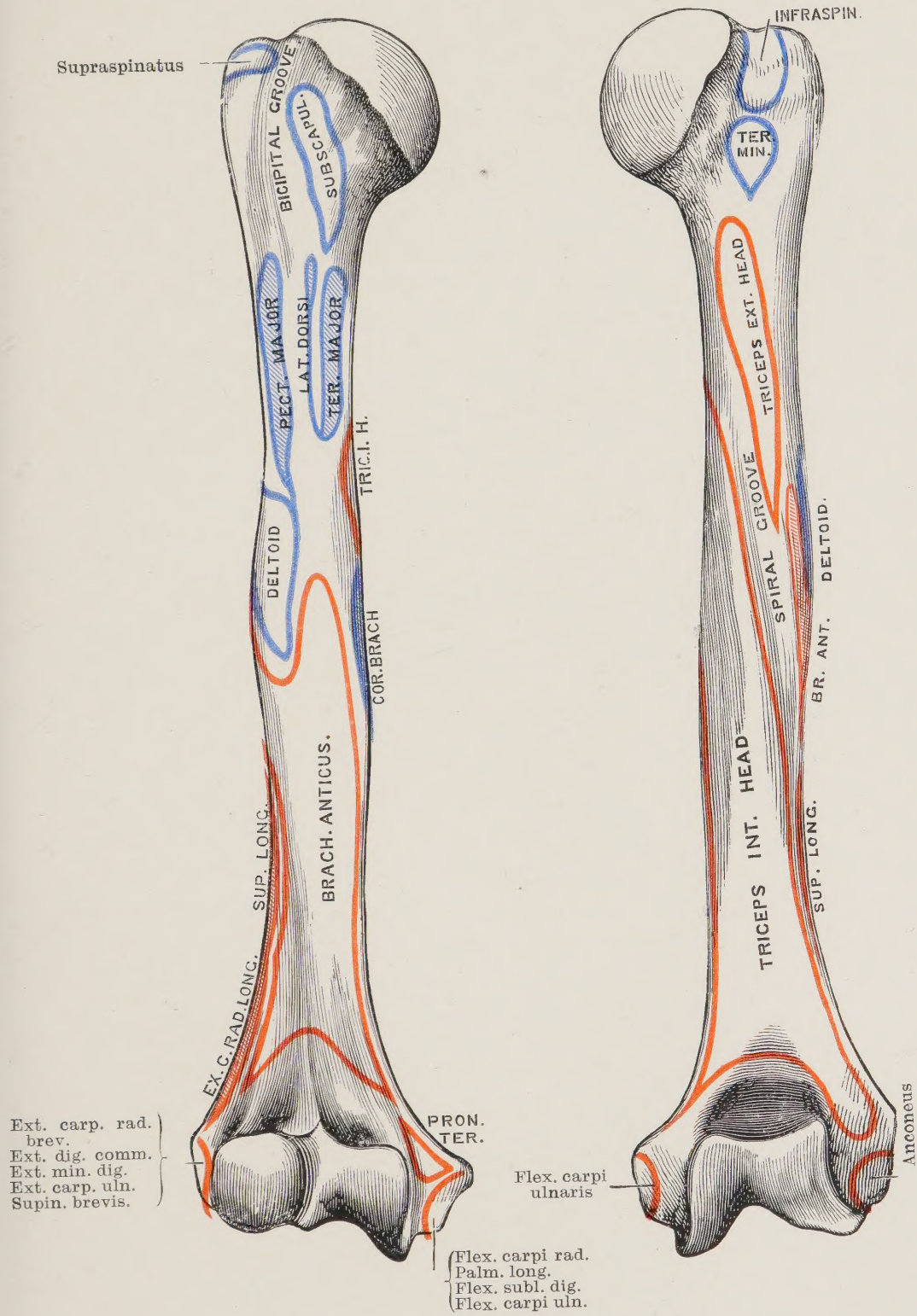
ACTION.—(1) It extends the elbow-joint; (2) through its scapular or long head it may adduct and retract the arm.

OLECRANON BURSA.—In all parts of the body where a

PLATE VI.

SHOWING THE MUSCULAR ATTACHMENTS ON THE HUMERUS.

(After Holden.)



process of bone projects beneath the skin, a bursa may be formed in the subcutaneous tissue. In the subcutaneous tissue over the olecranon process one can commonly be found (fig. 32). It allows the skin to move on the process when pressure is applied.

DISSECTION VIII

THE FLEXOR SURFACE OF THE FOREARM

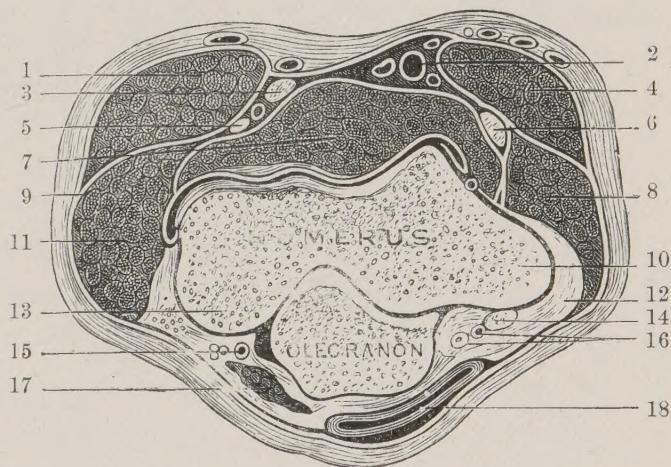
The Anticubital Space.—Two groups of flexor muscles pass into the forearm from the lower extremity of the humerus, one from the external condyle, the other from the internal (Plate VII). As the two flexor groups pass into the forearm, they converge and form the lateral boundaries of the anticubital space. A section across the space is shown in figure 32. If the student will observe what happens in his own arm when he flexes his elbow-joint, he will see that the anticubital space allows the forearm to be completely closed on the arm. He will feel the biceps tendon stand out in the space as an extremely rigid cord.

The structures in the superficial fascia over this space have

been already traced and removed. They were the median, median-basilic, and median-cephalic veins, and branches of the internal cutaneous and musculo-cutaneous nerves (fig. 23).

These structures were separated from the space by the deep fascia and bicipital aponeurosis, which form the *roof* of the space.

FIG. 32.—SHOWING THE ANTICUBITAL SPACE IN A SECTION OF THE ARM AT THE ELBOW-JOINT. (Heath.)



1. Supinator longus. 2. Brachial artery with venæ comites.
3. Tendon of biceps. 4. Pronator teres. 5. Musculo-spiral nerve with superior profunda artery. 6. Median nerve.
7. Brachialis anticus. 8. Origin of flexors. 9. Deep fascia.
10. Inner condyle. 11. Origin of extensors. 12. Internal lateral ligament. 13. Outer condyle. 14. Ulnar nerve. 15. Posterior interosseous recurrent vessels. 16. Posterior ulnar recurrent vessels. 17. Anconeus. 18. Olecranon bursa.

The deep fascia should be removed from the space and its boundaries defined and neatly cleaned.

BOUNDARIES.—*Externally.* Supinator longus.

Internally. Pronator teres.

Apex. The junction of these two muscles below.

Base. A line drawn between the two condyles of the humerus.

Floor. Brachialis anticus and supinator brevis.

To see the floor, the following contents of the space must be dissected out and a quantity of fat removed.

Contents of the Space (Plate VII and fig. 32).—1. The termination of the brachial artery and the two arteries derived from it, viz. radial and ulnar.

2. On the inner side of the artery lies the median nerve.

3. The tendon of the biceps.

4. If the supinator longus be lifted up, the termination of the musculo-spiral nerve, with its terminal branches (radial and posterior interosseous), will be found (fig. 30).

Front of the Forearm.—The student is now to proceed with the dissection of the forearm. Every structure examined in his part should be recognised in his own hand and forearm, remembering always that it is the living forearm which he seeks to understand, not the dead.

THE DEEP FASCIA OF THE FOREARM.—The superficial structures of the forearm have been already examined; the deep fascia should next be studied. It forms a continuous sheath over the muscles, binding them together and to the bones of the forearm. *Septa* pass from its deep surface and form sheaths for the muscles. These septa appear at the present stage of dissection as white lines on the surface of the fascia. Superiorly this fascia will be found continuous with the deep fascia of the arm. Near the elbow it is strengthened by the bicipital fascia. On the posterior aspect of the forearm it is much thicker and is attached to the posterior border of the ulna; here it is separated with difficulty from the underlying muscles, owing to the attachment of the muscles to the deep surface of the fascia, and also to the continuity which exists between the deep fascia and the fibrous septa which separate the muscles.

The Posterior Annular Ligament (Plate XIII).—At the back of the wrist the deep fascia becomes thickened by some transverse and oblique fibres which form the *posterior annular*

ligament. This ligament is attached externally to the lower end of the radius, and internally to the inner bones of the carpus, viz. cuneiform, pisiform, and unciform. Its deep surface is attached by processes to ridges on the dorsum of the radius, which separate the grooves for the extensor tendons. Compartments are thus formed for the passage of these tendons to the back of the hand. The posterior annular ligament retains the extensor tendons on the back of the wrist during extension.

On the front of the wrist the deep fascia is continuous with the anterior annular ligament, and is also partly continuous with the palmar fascia. Both of these structures will be described with the anatomy of the palm of the hand (Plate IX).

Muscles of the Flexor Aspect of the Forearm (see fig. 33 and Plate VII).—In dissecting out the muscles of the forearm, and more especially in dissecting the hand, the student will find it advantageous to fix the arm on a board. It prevents the part from shifting as the various structures are dissected out. The hand is most easily fixed by fine nails driven through the points of the fingers. The part above the elbow may be tied to the board. The hand is fixed first in the supine position, palm upwards.

(1) **Supinator Radii Longus (Brachio-radialis)** is one of the most powerful flexors of the forearm. It forms the outer boundary of the anticubital space (fig. 33). The deep fascia should be cleaned from it, exposing the origin, insertion, and borders of the muscle. The radial artery and nerve will be found beneath the anterior border of the muscle. The muscle which passes down behind it is the extensor carpi radialis longior.

ORIGIN.—From the upper two-thirds of the *external* supracondylar ridge of the humerus and from the external intermuscular septum. The origin covers the musculo-spiral nerve.

INSERTION.—It ends near the middle of the forearm on a flat tendon which is inserted to the radius at the base of the styloid process.

NERVE SUPPLY.—From the musculo-spiral.

ACTION.—It flexes the elbow-joint. It acts as a supinator when the forearm is completely pronated.

THE COMMON TENDON OF ORIGIN.—The student is now to examine the muscles of the forearm which rise from the *internal* condyle of the humerus (Plate VI). The deep fascia will be found adherent to the common mass of origin. The septa which dip in from the fascia between the origins of

the muscles also act as surfaces for attachment. Besides these there will be found a mass of tendinous fibres, attached to the internal condyle, from which the muscles take a common origin. This band of fibrous tissue is the *common tendon of origin*.

(2) The **Pronator Radii Teres** bounds the anticubital space internally. The deep fascia is to be reflected from its outer to its inner border, running the scalpel along its fibres from origin to insertion. It has two heads of origin; its deep head requires careful dissection.

ORIGIN.—From the common tendon, the surface of bone above and in front of the condyle, from the deep fascia and intermuscular septa. The small deep head rises from the inner margin of the coronoid process of the ulna (Plate VIII).

INSERTION.—Into a rough impression on the outer surface of the radius about its middle.

ACTION.—(1) it pronates the hand; (2) it flexes the elbow.

NERVE SUPPLY.—From the median.

The deep head of origin is a flattened slip which separates the median nerve from the ulnar artery. The median nerve passes between the two heads of the muscle. The radial artery crosses its insertion.

(3) The **Flexor Carpi Radialis** (fig. 33) lies at the inner side of the last muscle. The deep fascia is to be reflected from it and its tendon exposed to the wrist. Its insertion will be seen afterwards. The radial artery passes downwards at its outer or radial border.

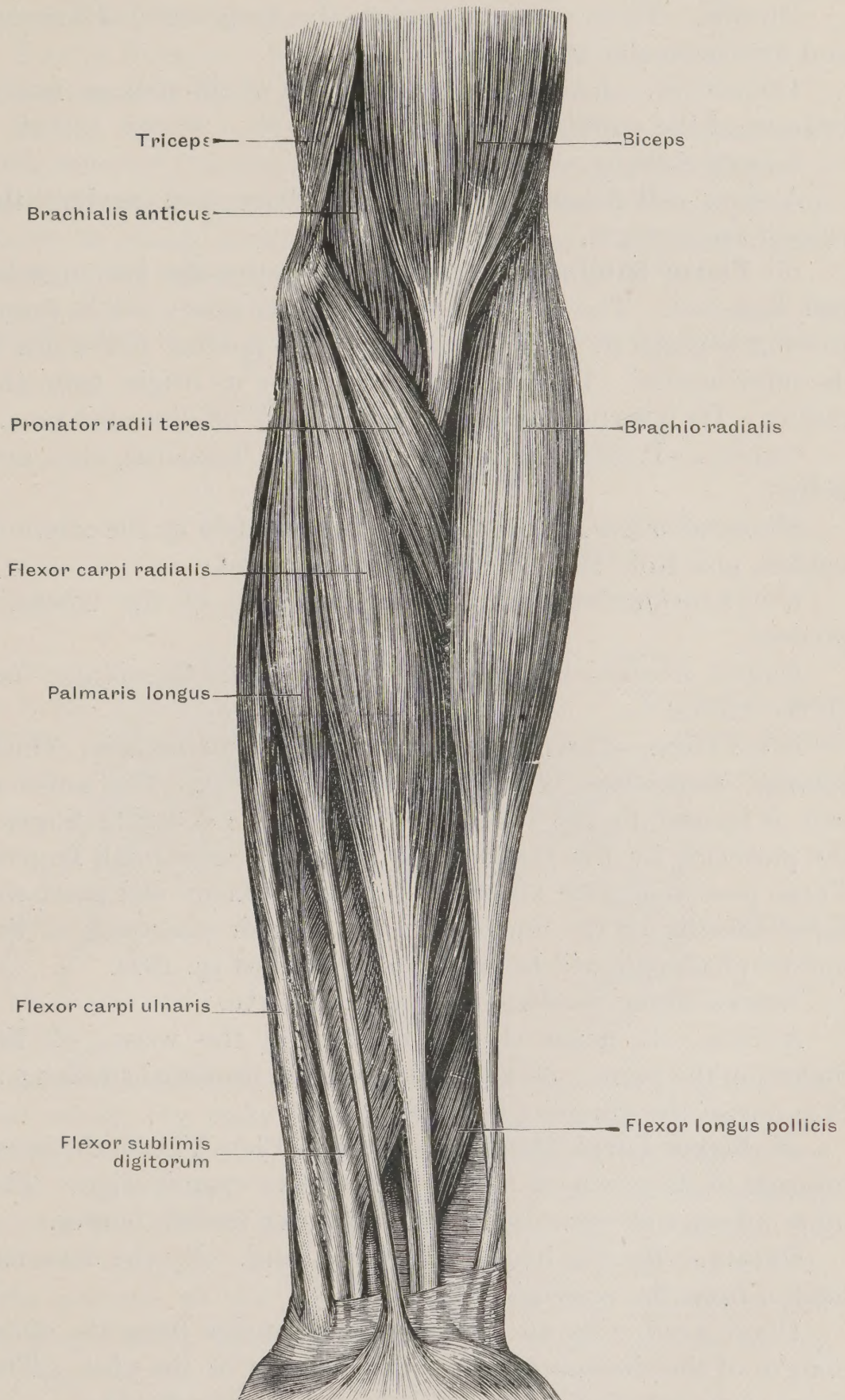
ORIGIN.—From the common tendon, deep fascia, and intermuscular septa between it and adjacent muscles.

INSERTION.—The tendon pierces the outer attachment of the anterior annular ligament, and passes in a groove on the trapezium to be inserted mainly into the base of the second metacarpal bone, giving off also a small slip to the base of the third.

NERVE SUPPLY.—From the median nerve.

ACTION.—It flexes the wrist and elbow.

(4) **Palmaris Longus** is one of the vestigial and most variable muscles of the body. It lies internal to the last muscle (fig. 33). When the student's wrist is flexed, the thin tendon of the palmaris stands out prominently in front, near the middle, if he has got one, for it is frequently absent. As the

FIG. 33.—FRONT OF THE FOREARM: FIRST LAYER OF MUSCLES. (*From Morris.*)

deep fascia is reflected, the tendon of the palmaris will be found to lie superficial to it at the wrist.

ORIGIN.—From common tendon, the deep fascia of forearm, and intermuscular septa.

INSERTION.—Into the central portion of the palmar fascia, in front of the annular ligament.

NERVE SUPPLY.—From the median.

ACTION.—It flexes the wrist and elbow, and renders the palmar fascia tense.

(5) **Flexor Sublimis Digitorum** lies deep to the two muscles just dissected. The median nerve and ulnar artery will be found passing beneath it. Above the wrist the median nerve lies at its outer border. The radial artery crosses its origin from the radius. Its insertion on the fingers cannot be dissected now.

ORIGIN.—It arises from the three bones, humerus, ulna, and radius.

Humeral origin.—From the internal condyle by the common tendon, also from the internal lateral ligament.

Ulnar origin.—From the inner margin of the coronoid process.

Radial origin.—By a thin fleshy sheet from the *oblique line* on the radius.

INSERTION.—The muscle terminates in four tendons which arrange themselves in two pairs at the wrist. The anterior pair is formed by the tendons of the middle and ring fingers, the posterior by the tendons for the index and small fingers. These pass under the anterior annular ligament and enter the flexor sheaths on the fingers (fig. 35). Their insertions to the middle phalanges will be subsequently traced (p. 101).

NERVE SUPPLY.—From the median nerve.

ACTION.—It flexes (1) the elbow; (2) the wrist; (3) the fingers on the palm; (4) the middle on the proximal phalanges. It is one of the grasping muscles.

(6) **Flexor Carpi Ulnaris** (fig. 33 and Plate VII) is the most internal of the group of muscles now under examination. The ulnar artery and nerve lie beneath its outer (radial) border.

ORIGIN.—By two heads: *Humeral head.*—By the common tendon from the internal condyle.

Ulnar head.—By an aponeurotic expansion from the outer margin of the olecranon and posterior border of the ulna. The ulnar nerve enters the forearm between the two heads.

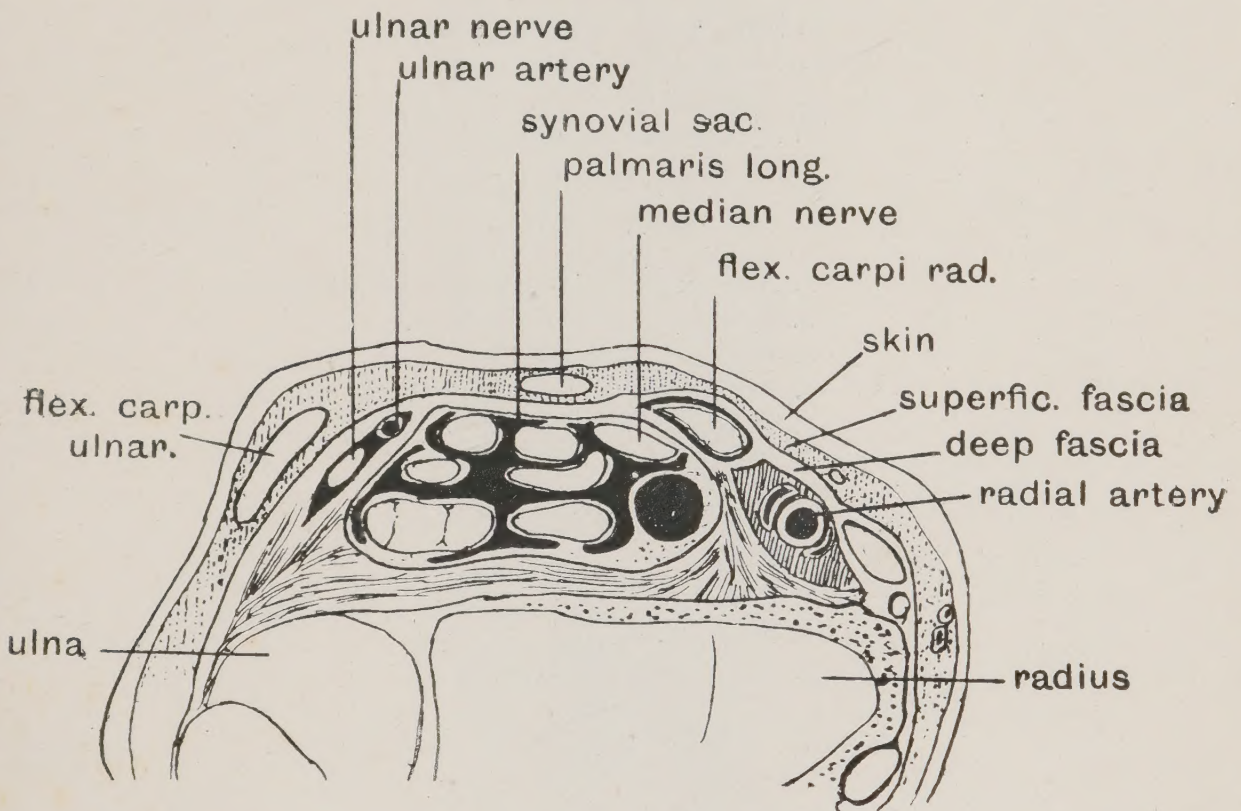
INSERTION.—Into the pisiform bone. A ligamentous band continues the tendon to the base of the fifth metacarpal bone and uncus of the unciform bone.

NERVE SUPPLY.—From the ulnar nerve.

ACTION.—It flexes the wrist and elbow.

Radial Artery.—If the student has carefully cleaned each of the muscles just described, he will find the radial artery comparatively easily exposed. The fibrous tissue which surrounds it must be cleared away. The venæ comites which accompany the artery are difficult to separate from it.

FIG. 34.—SHOWING THE STRUCTURES WHICH LIE SUPERFICIAL AND DEEP TO THE RADIAL ARTERY AT THE WRIST.



Special attention should be paid to the artery above the wrist where the *pulse* is felt (Plate X). It will be observed how the venæ comites, when distended, may obscure the artery to the finger touch. The artery above the wrist lies midway between the base of the styloid process of the radius and the tendon of the flexor carpi radialis. These will guide the student to the position of the artery. Only the skin, superficial and thin deep fascia, separate the artery from the finger in feeling the pulse (fig. 34).

COURSE.—The radial artery passes downwards from the

PLATE VII.

SHOWING THE STRUCTURES ON THE FLEXOR ASPECT
OF THE ELBOW.

Muscles.

- A. Biceps.
- B. Brachialis anticus.
- C. Supinator longus.
- D. Pronator radii teres.
- E. Flexor carpi radialis.
- F. Flexor sublimis digitorum.
- G. Flexor carpi ulnaris.
- H. Bicipital aponeurosis.

Nerves.

- 1. Anterior branch of internal cutaneous.
- 2. Median.
- 3. External cutaneous.
- 4. Radial.
- 5. Ulnar.

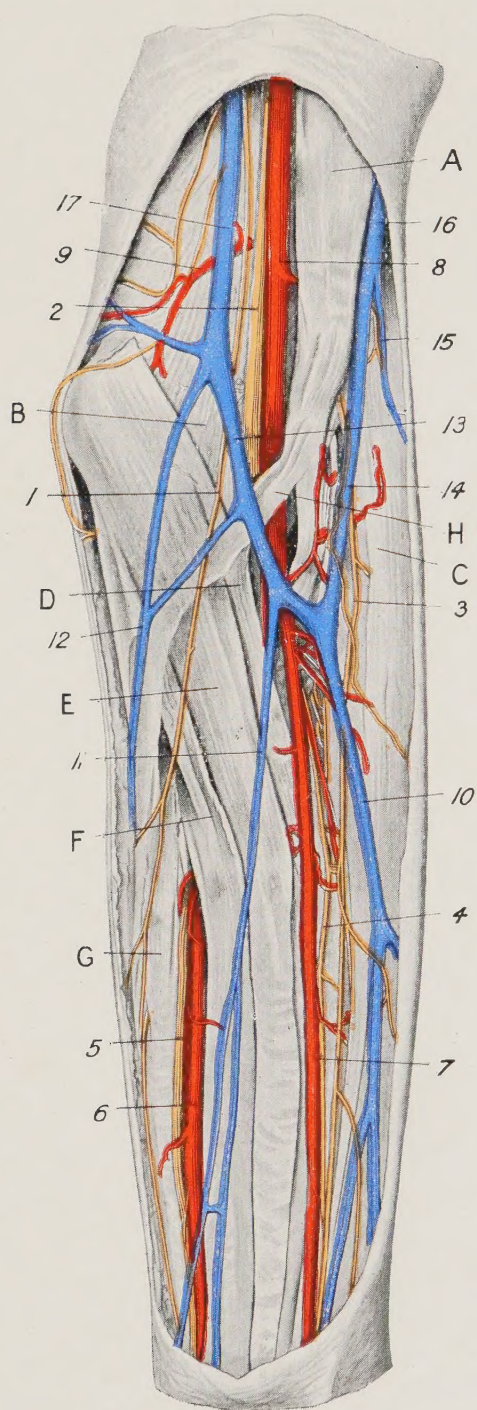
Arteries.

- 6. Ulnar.
- 7. Radial.
- 8. Brachial.
- 9. Anastomotica magna.

Veins.

- 10. Median.
- 11. Anterior ulnar.
- 12. Posterior ulnar.
- 13. Median-basilic.
- 14. Median-cephalic.
- 15. Radial.
- 16. Cephalic.
- 17. Basilic.

PLATE VII.



bend of the elbow to the front of the wrist, where it bends outwards over the outer side of the wrist-joint to reach the back of the carpus (Plate VII). There it passes through the upper part of the first interosseous space to reach the palm of the hand, where it terminates in the *deep palmar arch*. The radial is one of the terminal branches of the brachial. Its position in the forearm is indicated by a line drawn from the mid-condylar point in front of the elbow to a point at the wrist midway between the styloid process of the radius and tendon of the flexor carpi radialis.

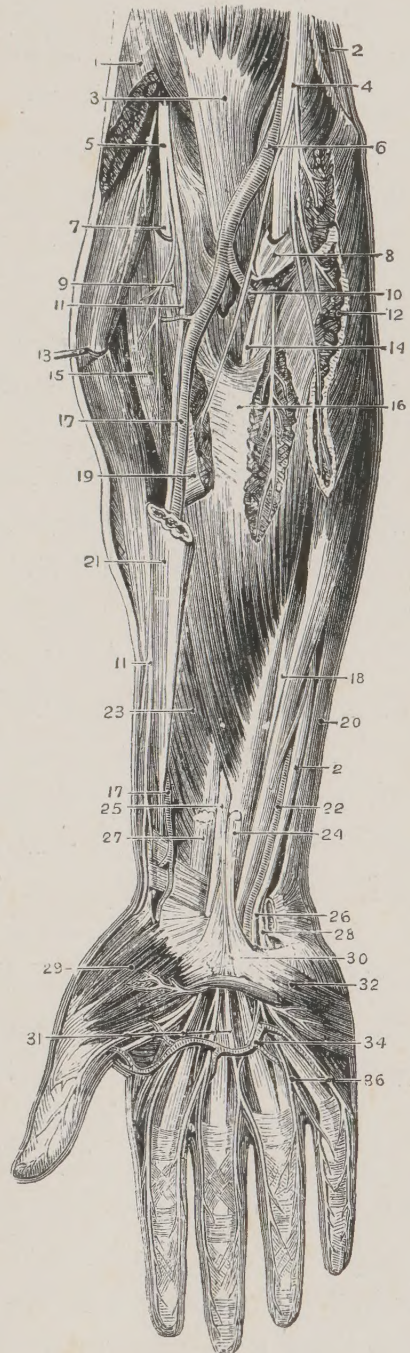
RELATIONS (in the forearm).—
Superficial. In addition to skin and fascia it is covered slightly by the edge of the supinator longus, and near its termination some twigs of the musculo-cutaneous nerve lie over it.

Externally.—Supinator longus, and, in its middle third, the radial nerve (fig. 35).

Internally.—Pronator radii teres and flexor carpi radialis.

Behind.—Tendon of biceps, supinator brevis, insertion of the pronator radii teres, radial head of the flexor sublimis digitorum, flexor longus pollicis, pronator quadratus, the lower end of the

FIG. 35.—SHOWING THE RADIAL NERVE AND ARTERY AND MEDIAN NERVE IN THE FOREARM. (*Hirschfeld and Leveillé.*)



1. Supinator longus (cut). 2, 2. Ulnar nerve. 3. Biceps.
4. Median nerve. 5. Musculo-spiral nerve. 6. Brachial artery. 7. Posterior interosseous nerve. 8. Pronator teres. 9. Supinator brevis. 10. Ulnar artery. 11, 11. Radial nerve. 12. Flexor carpi radialis (cut). 13. Extensor carpi radialis longior. 14. Anterior interosseous nerve. 15. Extensor carpi radialis brevior. 16. Flexor sublimis digitorum. 17, 17. Radial artery. 18. Flexor profundus digitorum. 19. Tendon of pronator teres. 20. Tendon of flexor carpi ulnaris. 21. Tendon of supinator longus. 22. Ulnar artery. 23. Flexor longus pollicis. 24. Tendon of palmaris longus. 25. Median nerve, becoming superficial. 26. Superficial division of ulnar nerve. 27. Tendon of flexor carpi radialis. 28. Deep branch of ulnar nerve. 29. Abductor pollicis. 30. Cutaneous palmar branch of median nerve. 31. Digital branches of median nerve. 32. Palmaris brevis. 34. Superficial palmar arch. 36. Digital branches of ulnar nerve.

radius. The pulse is felt against the lower end of the radius (fig. 34).

BRANCHES.—In the forearm :

- | | |
|-----------------------|-------------------------|
| (1) Radial recurrent. | (3) Anterior carpal. |
| (2) Muscular. | (4) Superficialis volæ. |

(1) The *radial recurrent artery* (fig. 28) is given off from the outer side of the artery near its origin. It passes transversely outwards and divides into numerous branches, which intertwine with the branches of the musculo-spiral nerve. Most of these enter the supinator longus and extensor carpi radialis longior, while one branch ascends beneath the former muscle to anastomose with the anterior branch of the superior profunda artery.

(2) Numerous minute *muscular branches* pass to the adjacent muscles.

(3) The *anterior carpal* is a small branch near the wrist. It passes transversely across the lower end of the radius, near the inferior border of the pronator quadratus, and anastomoses with the anterior ulnar carpal, thus forming the *anterior carpal arch*.

(4) The *superficialis volæ* (Plate X, E) is given off just before the radial artery leaves the front of the wrist. It passes over or through the short muscles of the thumb, and usually joins and completes the superficial palmar arch of the ulnar artery. Occasionally it terminates in the short muscles of the thumb, or it may be altogether absent.

DISSECTION.—Divide the pronator radii teres and the radial head of the flexor sublimis digitorum, and then turn these muscles inwards so as to expose the ulnar artery and median nerve.

Ulnar Artery is the larger terminal branch of the brachial (Plate VII). To indicate its position in the forearm, draw the following lines :—

(1) From a point midway between the olecranon process and the internal condyle to the outer border of the pisiform in the wrist ; the lower two-thirds of this line lies over the artery.

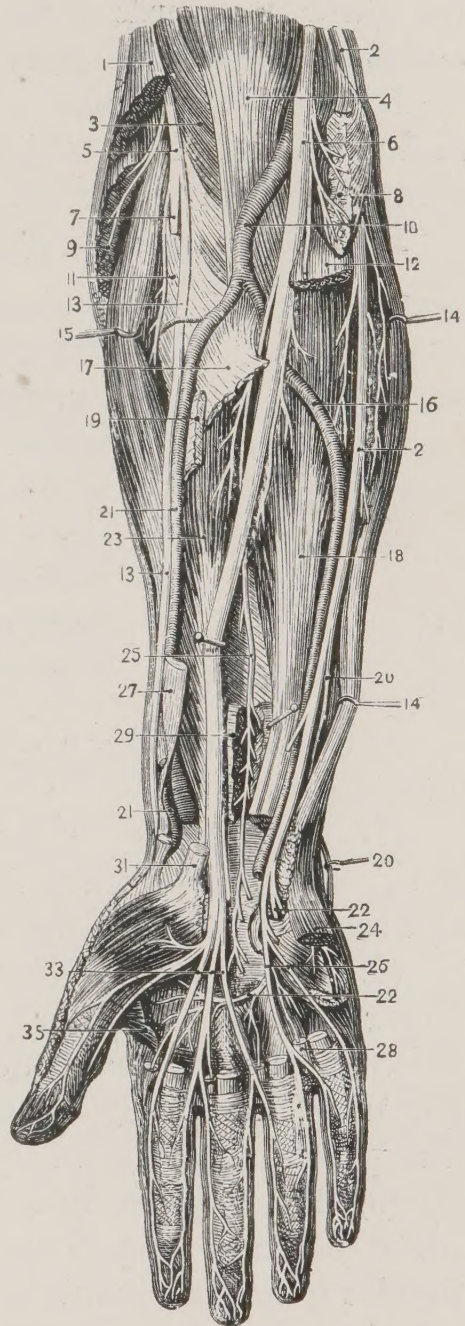
(2) From the mid-condylar point in front of the elbow to the line already drawn, at the junction of the upper and middle thirds of the forearm. The line just drawn indicates the position of the artery in the upper third of the forearm.

To expose the ulnar artery (1) it is necessary to detach the

origins of the pronator radii teres, flexor carpi radialis, palmaris longus, and flexor sublimis digitorum from the internal condyle and throw the muscle downwards. This must be neatly done, so that the muscles may be afterwards replaced in position and their relationships studied. (2) The deep head of the pronator radii teres, passing beneath the median nerve, must be divided. (3) By using the handle of the scalpel the mass of fibrous and fatty tissue which surrounds the ulnar artery in the antecubital space will be partially separated from the ulnar arteries. The venæ comites must be cleaned away, and the artery and branches exposed in the forearm.

COURSE.—The ulnar artery is larger than the radial, and lies deeply beneath the superficial group of muscles in the forearm. It extends downwards with a curved course in its upper third, bending obliquely inwards towards the inner border of the forearm. It is then continued directly downwards to the front of the wrist, where it passes over the anterior annular ligament to enter the palm of the hand on the outer side of the pisiform bone (fig. 36). In the palm it forms the superficial palmar arch (Plate X).

FIG. 36.—THE ULNAR AND MEDIAN NERVES IN THE FOREARM AND HAND. (*Hirschfeld and Leveillé.*)



1. Supinator longus (cut). 2, 2. Ulnar nerve. 3. Brachialis anticus. 4. Biceps. 5. Musculo-spiral nerve. 6. Median nerve. 7. Posterior interosseous nerve. 8. Pronator teres and flexor carpi radialis (cut). 9. Extensor carpi radialis longior (cut). 10. Brachial artery. 11. Supinator brevis. 12. Flexor sublimis digitorum (cut). 13. Radial nerve. 14, 14. Flexor carpi ulnaris. 15. Extensor carpi radialis brevior. 16. Ulnar artery. 17. Radial origin of flexor sublimis digitorum (cut). 18. Flexor profundus digitorum. 19. Tendon of pronator teres. 20, 20. Dorsal branch of ulnar nerve. 21, 21. Radial artery. 22, 22. Deep branch of ulnar nerve. 23. Flexor longus pollicis. 24. Abductor minimi digiti. 25. Anterior interosseous nerve. 26. Digital branches of ulnar nerve. 27. Tendon of supinator longus. 28. One of the lumbricales. 29. Pronator quadratus. 31. Tendon of flexor carpi radialis. 33. Digital branches of median nerve. 35. Adductor transversus pollicis.

RELATIONS (in the forearm).—*Superficial.* Skin and fasciæ; pronator radii teres, flexor carpi radialis, flexor sublimis digitorum, palmaris longus, and the overlapping border of the flexor carpi ulnaris. Near its commencement it is crossed by the median nerve. At the wrist the artery is quite superficial.

Inner Side.—Flexor carpi ulnaris and the ulnar nerve in the lower two-thirds of its course. The nerve is separated by an interval from the artery in its upper third.

Behind.—Brachialis anticus (for a short distance), flexor profundus digitorum, which separates the artery from the ulna above and from the pronator quadratus below.

BRANCHES (figs. 28, 53) must be followed out one by one.

In the forearm.

1. Anterior ulnar recurrent.
2. Posterior ulnar recurrent.
3. Common interosseous.
 - a. Anterior interosseous.
 - b. Posterior interosseous.
4. Muscular.
5. Anterior ulnar carpal.
6. Posterior ulnar carpal.

The three arteries first in the list will be found in the antecubital space.

(1) The *anterior ulnar recurrent* passes upwards beneath the pronator radii teres, lying on the brachialis anticus, and anastomoses with the anastomotica magna.

(2) The *posterior ulnar recurrent* (fig. 29) is much larger than the anterior, and passes upwards to the interval between the internal condyle and olecranon, where it lies with the ulnar nerve and anastomoses with the inferior profunda and posterior branch of the anastomotica magna.

(3) The *common interosseous* artery is a short thick trunk given off near the commencement of the ulnar artery. It divides immediately into the *anterior* and *posterior interosseous* arteries (fig. 28). The anterior interosseous can be traced on the anterior surface of the interosseous membrane, between the two deep flexor muscles. The posterior interosseous passes backwards between the radius and ulna, through the hiatus above the interosseous membrane. It will be dissected on the back of the forearm (Plate XIII).

The *anterior interosseous* artery passes down on the anterior surface of the interosseous membrane, between the flexor profundus digitorum and flexor longus pollicis. When it reaches the upper border of the pronator quadratus it pierces the interosseous membrane and is continued down to the back of the wrist (Plate XIII), where it enters a plexus formed by the posterior carpal arteries.

The *anterior interosseous* gives off the following branches :

- a. Medullary.
- b. Comes nervi mediani.
- c. Muscular.
- d. Anterior carpal communicating.

(a) *Nutrient* or *medullary* to the radius and ulna. They enter the bones near the middle of the forearm.

(b) *Comes nervi mediani* or median artery passes down with the median nerve in the forearm. This artery is sometimes enlarged, and passes into the palm beneath the anterior annular ligament to join the superficial palmar arch.

(c) Numerous *muscular branches*.

(d) The *anterior carpal communicating* passes down beneath the pronator quadratus to form a plexus with the anterior carpal branches of the radial.

(4) *Muscular branches* from the ulnar artery.

(5) The *anterior ulnar carpal* passes beneath the flexor profundus digitorum, and with the anterior carpal of the radial forms, in front of the wrist, a plexus or arch, the *anterior carpal arch*.

(6) The *posterior ulnar carpal* (Plate X) passes beneath the flexor carpi ulnaris near the pisiform bone and ramifies on the back of the carpus beneath the extensor tendons, forming with the posterior radial carpal the *posterior carpal arch*. From this arch the second and third dorsal interosseous arteries are given off to the back of the hand.

The nerves which pass to the hand among the flexor muscles of the forearm are now to be traced. There are two, the median and ulnar.

Median Nerve.—This nerve has been seen in the antecubital fossa, lying on the inner side of the brachial artery. Below the

elbow it crosses the ulnar artery and passes between the two heads of the pronator radii teres (fig. 35). It is continued down the forearm between the superficial and deep muscles. Near the wrist it becomes superficial, and appears between the flexor carpi radialis and flexor sublimis digitorum, and then enters the palm of the hand beneath the anterior annular ligament (fig. 36). Lying upon or within the nerve is the *arteria comes nervi mediani*, a branch of the anterior interosseous artery.

BRANCHES.—(a) *Muscular branches* to the pronator radii teres, palmaris longus, flexor carpi radialis, and flexor sublimis digitorum.

(b) *Anterior interosseous nerve* (fig. 36). This branch accompanies the anterior interosseous artery. It supplies the flexor longus pollicis and in part the flexor profundus digitorum, between which it lies. It passes beneath the pronator quadratus, where it terminates by dividing into muscular branches which enter the muscle, and articular twigs which reach the carpal joints.

(c) The *palmar cutaneous branch* (fig. 23) is given off above the wrist and appears in the interval between the flexor carpi radialis and palmaris longus. It passes over the annular ligament to supply the skin over the middle and outer side of the palm of the hand.

Ulnar Nerve in the Forearm.—The ulnar nerve leaves the upper arm in the interval between the internal condyle and olecranon. It enters the forearm between the two heads of the flexor carpi ulnaris and passes down beneath this muscle. It reaches the inner side of the ulnar artery just below its upper third, and passes downwards on the inner side of the artery to the wrist (fig. 36). It enters the palm of the hand with the artery and over the anterior annular ligament, close to the outer side of the pisiform bone (fig. 43).

BRANCHES.—(a) *Articular* to the elbow-joint.

(b) *Muscular* to the flexor carpi ulnaris and inner half of the flexor profundus digitorum.

(c) *Palmar cutaneous*.—This is given off about the middle of the forearm, and passes down on the surface of the ulnar artery and ends in the skin of the inner part of the palm (fig. 23).

(d) *Dorsal cutaneous*.—This arises about two inches above the wrist and passes backwards under the tendon of the flexor

carpi ulnaris and over the tendon of the extensor carpi ulnaris. It communicates with the radial nerve of the back of the hand, and supplies branches to the inner side of the little finger and to the adjacent sides of the little and ring fingers (fig. 22).

Deep Muscles of the Front of the Forearm. — Most of the superficial muscles of the forearm have already been detached at their origin and thrown downwards. The supinator longus, the deep head of the pronator radii teres, and the extensive origin of the flexor carpi ulnaris should be detached now so as to expose the two deep flexor muscles of the forearm—the *flexor profundus digitorum* and *flexor longus pollicis* (fig. 37).

Flexor Profundus Digitorum.—

ORIGIN. Anterior and internal surfaces of the ulna (upper two thirds), inner part of interosseous membrane, and the aponeurosis attached to the posterior border of the ulna.

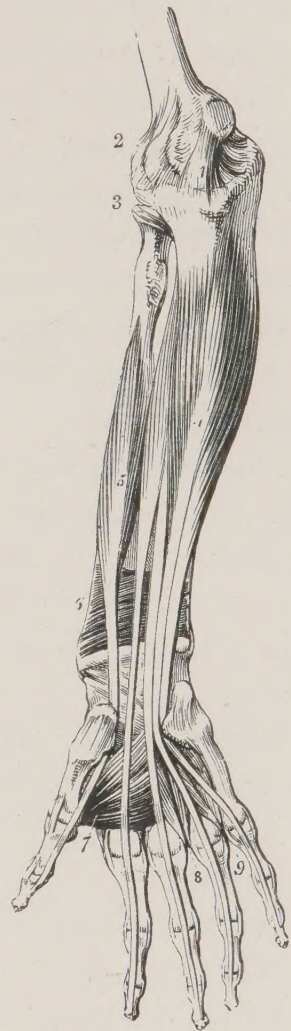
INSERTION.—By four tendons into the bases of the terminal phalanges of the four fingers. The insertion will be seen in the dissection of the hand (fig. 37 and Plate XI).

The outer tendon (to the index finger) arises high in the forearm and forms almost a separate muscle (flexor indicis).

As the tendons pass beneath the anterior annular ligament to enter the palm they are surrounded by a loose saccular synovial membrane (fig. 34). In the fingers each tendon lies within a vaginal ligament (fig. 40). In front of the first phalanx in each finger, the flexor profundus perforates the split tendon of the flexor sublimis.

NERVE SUPPLY.—From both the median (anterior interosseous) and ulnar nerves.

FIG. 37.—THE DEEP FLEXOR MUSCLES OF THE FORE-ARM. (Wilson.)



1. Internal lateral ligament of the elbow-joint. 2. Anterior ligament. 3. Orbicular ligament of the head of the radius. 4. Flexor profundus digitorum. 5. Flexor longus pollicis. 6. Pronator quadratus. 7. Adductor pollicis. 8. Dorsal interosseous of the middle, and palmar interosseous of the ring finger. 9. Dorsal interosseous muscle of the ring finger, and palmar interosseous of the little finger.

ACTION.—It produces flexion at (1) the interphalangeal joints; (2) the metacarpo-phalangeal joints; (3) the wrist-joint.

Flexor Longus Pollicis (fig. 37).—**ORIGIN.** From the anterior surface of the radius below the oblique line, and from the outer part of the interosseous membrane, and, usually, by a second head from the inner border of the coronoid process of the ulna or inner condyle of the humerus.

INSERTION.—Its tendon passes beneath the outer part of the anterior annular ligament to reach the base of the terminal phalanx of the thumb. Its tendon is surrounded by a synovial membrane from the upper border of the anterior annular ligament to its insertion (fig. 38).

NERVE SUPPLY.—From the anterior interosseous nerve.

ACTION.—It flexes the thumb; it is one of the strongest grasping muscles.

The two deep flexor muscles, just dissected, are to be raised from the bone and thrown downwards. A small transverse quadratus muscle above the wrist is then exposed. The deep flexor muscles must be raised carefully, because, when studying their action in the fingers, it will be necessary to replace them *in situ*.

Pronator Quadratus.—**ORIGIN.** From an oblique ridge on the anterior surface of the ulna in its lower fourth.

INSERTION.—To the lower fourth of the anterior surface of the radius.

NERVE SUPPLY.—From the anterior interosseous.

ACTION.—It rotates the lower end of the radius on the ulna.

This muscle will be seen to rest on the interosseous membrane. The anterior interosseous artery and nerve pass beneath it. The radial artery crosses its anterior surface.

DISSECTION IX

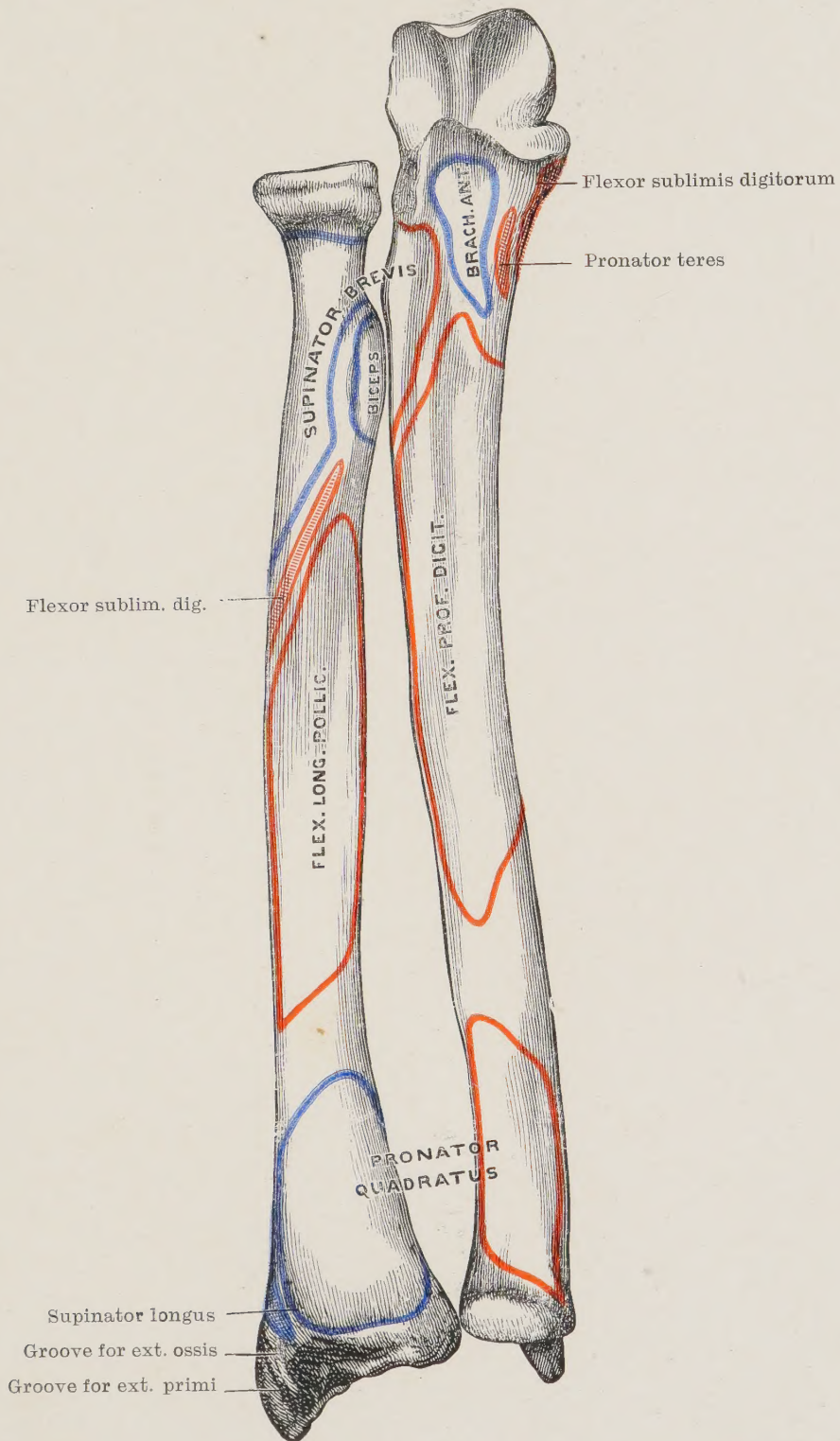
THE PALM OF THE HAND

Surface Markings of the Palm.—Before commencing the dissection of the palm, the student should observe the following points in his left hand:

- (1) The ball of the thumb (*thenar eminence*) caused by the

PLATE VIII.

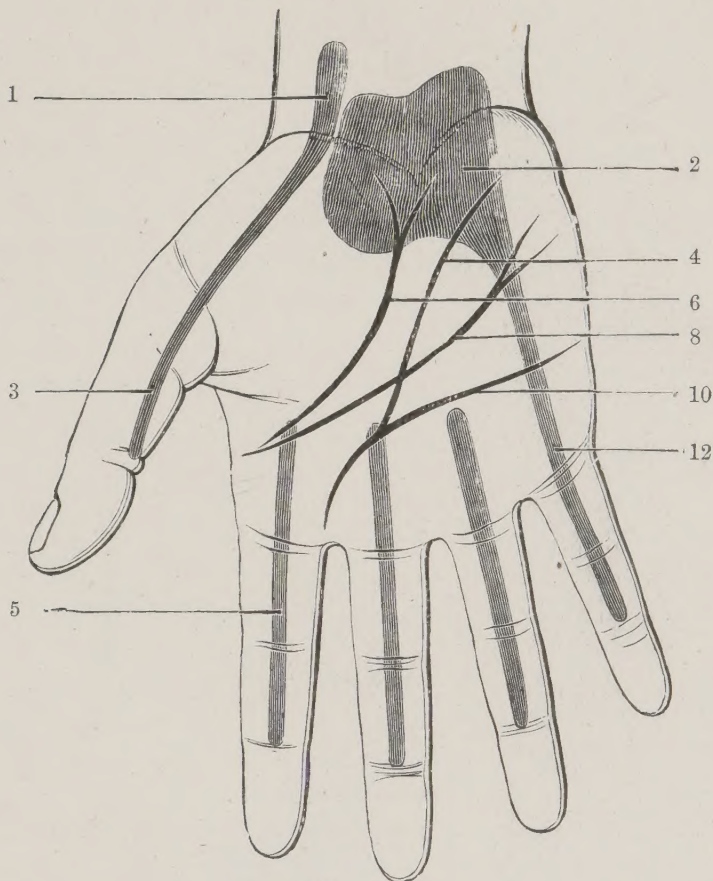
THE MUSCULAR ATTACHMENTS ON THE FLEXOR ASPECT OF
THE RADIUS AND ULNA. (*After Holden.*)



group of short muscles which move the thumb (Plate IX). At its base a crescentic line occurs (*linea vitæ*, fig. 38) which the student will see is produced by the flexion of the thumb on the palm.

(2) The *hypothenar eminence* on the ulnar border of the palm, due to the group of short muscles which act on the little finger. When the thumb and little finger are apposed a flexion line appears between the *linea vitæ* and the *hypothenar eminence*

FIG. 38.—SHOWING THE LINES OF THE PALM AND POSITION OF THE SYNOVIAL SHEATHS. (*Heath.*)



1. Carpal sheath of flexor longus pollicis. 2. Carpal sheath of flexors sublimis and profundus. 3. Digital sheath of flexor longus pollicis. 4. Linea hepatica. 5. Digital sheath of index finger. 6. Linea vitæ. 8. Proximal flexion fold. 10. Distal flexion fold. 12. Digital sheath of little finger.

(fig. 38). It is the *linea hepatica*, or the palmist's line of fate.

(3) Two transverse lines on the palm. They lie opposite the heads of the metacarpals and are produced by flexion of the knuckle or metacarpo-phalangeal joints. They sometimes run into each other, but as a rule are separate. The double fold is due to the metacarpal bones being unequal in length, as the student may verify by inspecting the knuckles of the closed

PLATE IX.

SUPERFICIAL STRUCTURES OF THE PALM.

Arteries.

- A. Radial.
- B. Ulnar.
- C. Digital dividing into collateral.
- D. Princeps indicis.

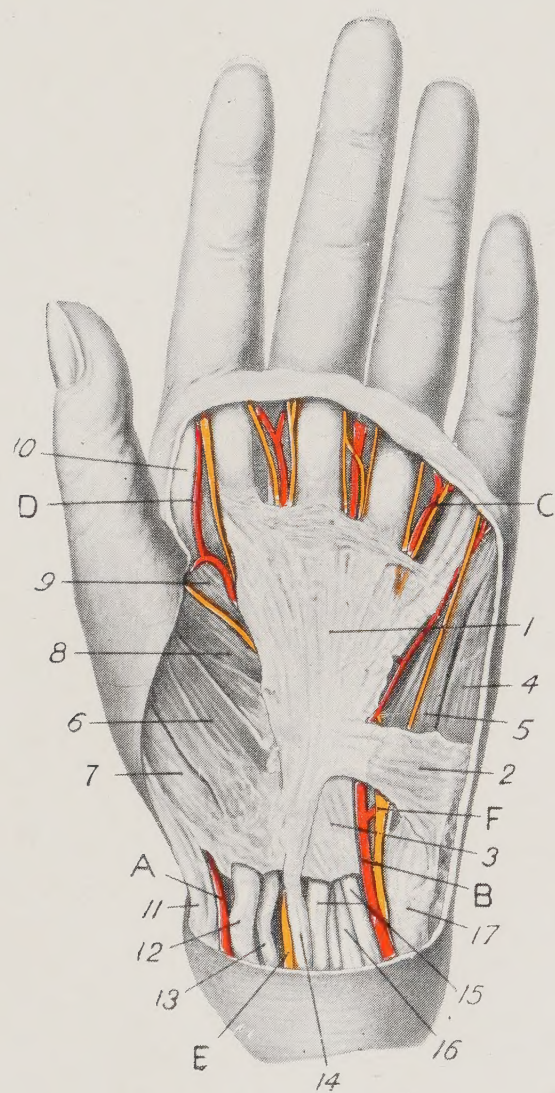
Nerves.

- E. Median.
- F. Ulnar.

Muscles and Tendons.

- 1. Palmar fascia.
- 2. Palmaris brevis.
- 3. Anterior annular ligament.
- 4. Abductor minimi digiti.
- 5. Flexor brevis minimi digiti.
- 6. Abductor pollicis.
- 7. Opponens pollicis.
- 8. Flexor brevis pollicis (radial head).
- 9. Adductor transversus pollicis.
- 10. Tendon of first lumbricalis.
- 11. Tendon of extensor ossis metacarpi pollicis.
- 12. Tendon of flexor carpi radialis.
- 13. Tendon of flexor longus pollicis.
- 14. Tendon of palmaris longus.
- 15. Tendons of flexor sublimis digitorum.
- 16. Tendons of flexor profundus digitorum.
- 17. Tendon of flexor carpi ulnaris.

PLATE IX.



hand. The *superficial palmar arch* (fig. 39) crosses the palm above the upper transverse line.

(4) The bases of the 2nd and 5th metacarpal bones on the margin of the hand. A line drawn across the palm from the base of the one to the base of the other marks the position of the *deep palmar arch* (fig. 39).

(5) The *pisiform bone*, with the tendon of the flexor carpi ulnaris joining it.

(6) The *tuberosity of the scaphoid* between the wrist and ball of the thumb. It is situate half an inch below and internal to the styloid process of the radius.

(7) The upper border of the *anterior annular ligament* stretches between the two points just mentioned: the skin lines, caused by flexion of the wrist, cross at the upper border of the ligament.

REFLECTION OF THE SKIN.—The skin is to be removed from the palm of the hand. It is most easily reflected by making two incisions: (1) along the ulnar border of the palm, continuing it along the border of the little finger; (2) from the base to the point of the thumb along its outer border. The skin is then reflected from the margins towards the centre or hollow of the palm. Over the thenar and hypothenar eminence it will be found easily detached, but in the centre of the palm, where it is bound closely to the central part of the palmar fascia, its reflection is a much more difficult matter (Plate IX). The skin is to be removed at the same time from the palmar aspects of the fingers and thumb. At the bases of the fingers, slips of the palmar fascia end in the skin and must be cut as the skin is reflected.

Superficial Structures of the Palm (Plate IX).—The following structures are now to be examined :

- | | |
|-------------------------|----------------------------------|
| (1) Cutaneous nerves. | (3) Palmar fascia. |
| (2) Palmaris brevis. | (4) The superficial palmar arch. |
| (5) The Digital nerves. | |

PALMAR BRANCHES OF THE MEDIAN AND ULNAR NERVES. These have already been found in the forearm (p. 61, and fig. 23).

The PALMARIS BREVIS (Plate IX) is a thin layer of muscle which arises from the inner edge of the central part of the palmar fascia, and is inserted into the deep surface of the

skin of the inner border of the hand, opposite the upper part of the hypothenar eminence. This muscle varies much in its development, and may be entirely absent.

NERVE SUPPLY.—From the ulnar nerve as it passes beneath the muscle.

ACTION.—It draws the skin covering the hypothenar eminence towards the centre of the palm as the fingers are closed.

Palmar Fascia (Plate IX).—The superficial structures, just mentioned, should now be removed and the palmar fascia carefully cleaned. Clean specially the central portion, and notice the processes or divisions of its basal portion towards the fingers. Dissect the digital arteries and nerves which pass between these processes towards the clefts of the fingers (Plate IX). Note the transverse fascial fibres which arch between the processes over the digital vessels and nerves.

The palmar fascia consists of three parts, a *central* and two *lateral*, the lateral portions being merely thin layers which cover the short muscles of the thumb and little finger.

The *central portion* is a dense triangular layer of fascia, whose *apex* is attached to the anterior annular ligament and receives the insertion of the palmaris longus. The *base* is directed towards the fingers, and opposite the heads of the metacarpal bones divides into four slips which pass towards the fingers. Each slip spreads out on the proximal part of the flexor tendon sheath (ligamentum vaginales), some of its fibres being attached to the sheath, while others pass down on each side of the sheath to be attached partly to the transverse metacarpal ligament, and partly into the proximal phalanges.

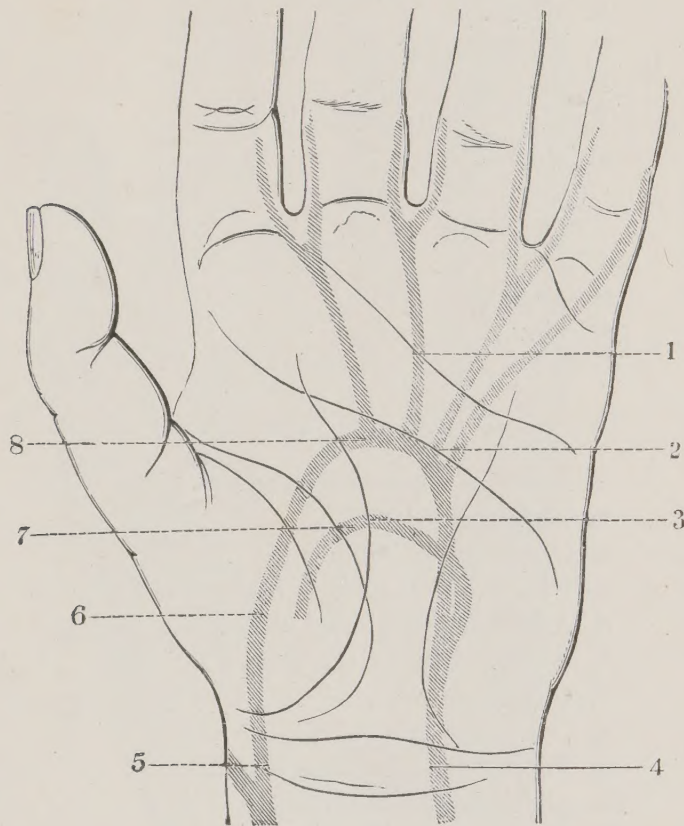
Between the slips the digital vessels and nerves pass towards the clefts of the fingers, while passing across between these slips and over the vessels and nerves will be found well-marked *transverse* fibres (the superficial transverse ligament).

From the lateral margins of the central fascia two thin septa may be made out, dipping into the palm of the hand. They separate the short muscles of the thumb and little finger from the tendons, vessels, and nerves which occupy the middle compartment of the palm.

The Superficial Palmar Arch (Plate X).—Reflect the palmar fascia by detaching and turning its apex towards the

fingers. Clean the superficial palmar arch and median nerve which lie underneath the fascia. Trace the digital vessels and nerves along the lateral margins of the digits. The *ulnar artery* (Plate X), having entered the palm by passing over the anterior annular ligament, gives off a large *deep branch* which dips deeply into the palm of the hand between the abductor and flexor brevis minimi digiti, to join, with the radial artery, in the formation of the deep palmar arch. The continuation of the ulnar artery curves outwards across the

FIG. 39.—SHOWING THE POSITION OF THE SUPERFICIAL AND DEEP PALMAR ARCHES. (Heath.)



1. Distal fold. 2. Middle proximal fold. 3. Linea vitæ. 4. Ulnar artery. 5. Radial artery.
6. Superficialis volæ. 7. Deep palmar arch. 8. Superficial palmar arch.

palm towards the thumb and forms the *superficial palmar arch*, which is completed by a branch of the *radialis indicis*, or superficial volar branch of the radial (Plate X). The convexity of the arch is towards the fingers, and just reaches a line drawn across the palm from the ulnar margin of the abducted thumb (fig. 39).

RELATIONS OF SUPERFICIAL PALMAR ARCH (Plate X).—*Superficially.* Skin, superficial fascia, cutaneous branches of median and ulnar nerves, palmaris brevis, and palmar fascia.

PLATE X.

STRUCTURES BENEATH THE PALMAR FASCIA.

Arteries.

- A. Radial.
- B. Ulnar.
- C. Superficial palmar arch.
- D. Princeps indicis.
- E. Superficialis volæ.
- F. Digital.

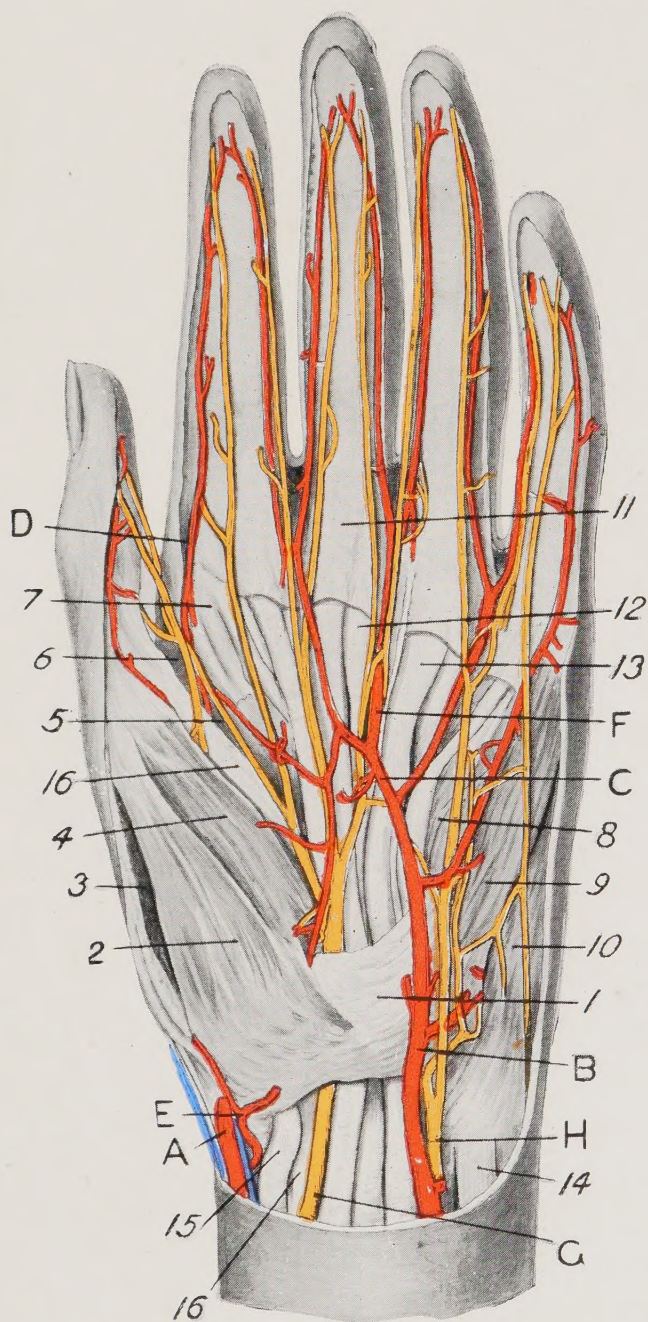
Nerves.

- G. Median.
- H. Ulnar.

Muscles and Tendons.

- 1. Anterior annular ligament.
- 2. Abductor pollicis.
- 3. Opponens pollicis.
- 4. Flexor brevis pollicis (radial head).
- 5. Adductor obliquus pollicis.
- 6. Adductor transversus pollicis.
- 7. First lumbrical.
- 8. Opponens minimi digiti.
- 9. Flexor brevis minimi digiti.
- 10. Abductor minimi digiti.
- 11. Vaginal sheath.
- 12. Tendon of flexor profundus digitorum.
- 13. Tendon of flexor sublimis digitorum.
- 14. Tendon of flexor carpi ulnaris.
- 15. Tendon of flexor carpi radialis.
- 16. Tendon of flexor longus pollicis.

PLATE X.



Beneath.—Anterior annular ligament, short muscles of little finger, flexor tendons and digital branches of the median nerve (Plate X).

Branches.—*Four digital arteries* and small muscular and cutaneous twigs arise from the arch. In the palm the digital arteries are superficial to the digital nerves, but on the fingers the position is reversed, the nerves being the more superficial.

The *first* digital branch passes to the ulnar side of the little finger. The second, third and fourth digital branches pass to the clefts between the fingers, and divide into the *collateral digital arteries*, which pass with the digital nerves along the sides of the fingers towards their tips. They form an arterial arch in the pulp of each finger. In their passage along the fingers they supply branches to the tendon sheaths, interphalangeal joints, and skin of the palmar surface. Opposite the first and second phalanges, dorsal branches are given off to supply the skin on the dorsal aspect of the fingers.

Before the digital arteries divide, just above the clefts of the fingers, they receive the *interosseous branches* of the deep palmar arch (Plate XI).

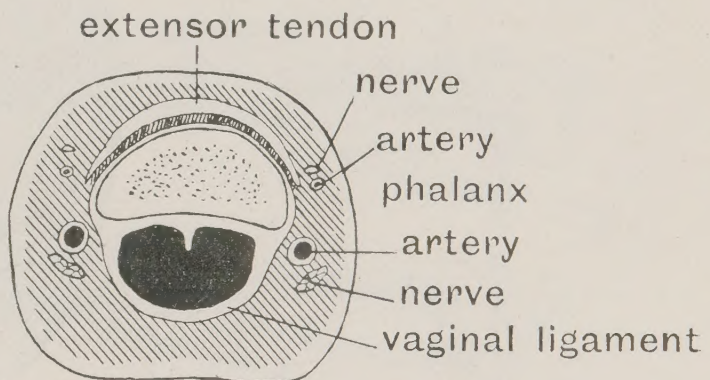
Nerves of the Palm.—Two great nerves enter the palm to terminate in the hand—the *median* and *ulnar*. The median enters beneath the annular ligament, while the ulnar passes the outer side of the pisiform bone on the superficial aspect of the ligament.

The Median Nerve in the Hand (fig. 36).—This nerve has already been traced to the front of the wrist, where it lies between the flexor carpi radialis and the flexor sublimis digitorum. It then passes beneath the anterior annular ligament and divides in the palm into an outer and inner division.

The *outer division* gives off:—

(1) A branch to supply the short muscles of the thumb, viz. the abductor, opponens, and superficial or outer head of the flexor brevis pollicis.

FIG. 40.—A SECTION OF A FINGER.
(Diagrammatic.)

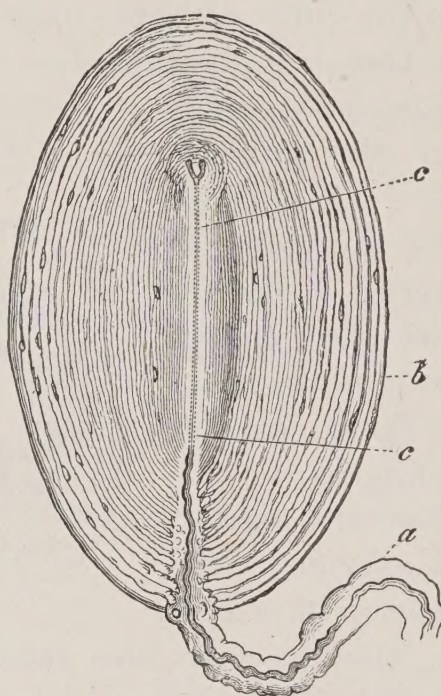


(2) Digital branches to the outer side of the thumb and adjacent sides of the thumb and index finger. The branch which passes to the outer side of the index finger supplies the first or outermost lumbrical muscle (fig. 36).

The *inner division* gives off two branches which pass towards the clefts between the index, middle, and ring fingers. Near the clefts they divide into collateral digital branches for these fingers. The nerve which passes towards the cleft between the index and ring fingers supplies the second lumbrical muscle.

FIG. 41A.—PACINIAN CORPUSCLE FROM THE MESENTERY OF A CAT.

FIG. 41.—PORTION OF A DIGITAL NERVE, SHOWING THE DISPOSITION OF THE PACINIAN CORPUSCLES.



a. A nerve forming the stalk. *b.* The system of capsules. *c, c.* Axial canal or internal bulb, within which the axis-cylinder ends forked.

In its course along a finger a digital nerve supplies branches to the skin on the palmar surface, and also twigs to the dorsal aspect over the middle and distal phalanges. At its termination each nerve supplies branches to the pulp of the finger and the matrix of the nail.

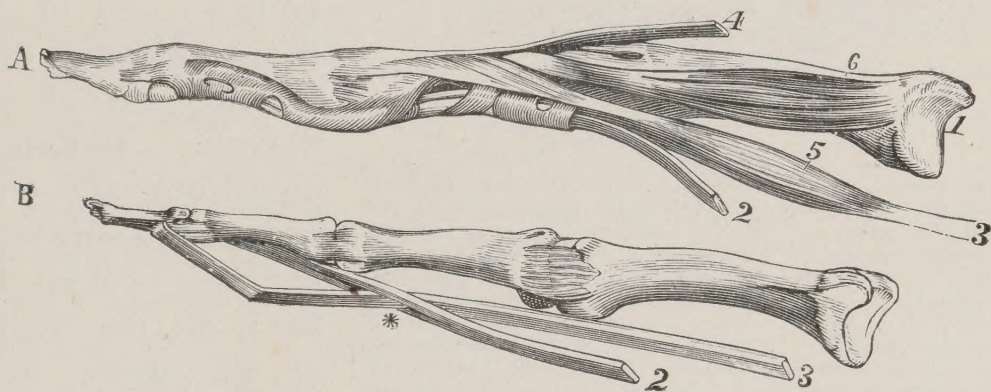
PACINIAN CORPUSCLES.—On the fingers many twigs of the collateral digital nerves will be found to terminate in Pacinian corpuscles—spindle-shaped bodies of the size of a grape-stone imbedded in the subcutaneous tissue. They are probably concerned in the sense of touch (figs. 41 and 41A).

Ulnar Nerve (fig. 36).—This nerve has been seen entering the palm with the ulnar artery. Over the anterior annular ligament it lies between the artery and the pisiform bone, and divides almost immediately into a superficial and a deep branch.

The *superficial branch* supplies the palmaris brevis and divides into two branches, the inner of which supplies the inner side of the little finger and the outer communicates with the inner branch of the median in the palm and divides to supply digital branches to the adjacent sides of the little and ring fingers (fig. 36). These branches are distributed on the fingers in a manner similar to the branches of the median nerve.

The *deep branch* (fig. 36) passes with the deep branch of the ulnar artery between the abductor and flexor brevis minimi digiti, and will be traced in the deep dissection of the palm.

FIG. 42.—SHOWING THE INSERTION OF MUSCLES OF A DIGIT. (Wilson.)



In A the tendons of the flexor muscles are bound to the bone by the fibrous sheath. In B the sheath has been removed, as well as the vincula accessoria. 1. Metacarpal bone. 2. Tendon of the flexor sublimis. 3. Tendon of the flexor profundus. * Perforation of the sublimis by the profundus tendon. 4. Tendon of the extensor communis digitorum. 5. Lumbricalis muscle. 6. One of the interossei muscles.

Anterior Annular Ligament (fig. 43).—This is a thick band of fascia in front of the carpus which binds down the flexor tendons and keeps them from springing forwards like the string of a bow every time the wrist is flexed.

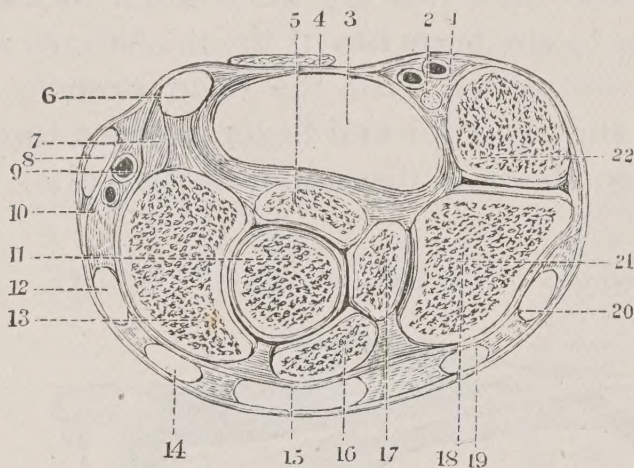
ATTACHMENTS.—*Externally* it is attached to the tubercle of the scaphoid and to the margins of the groove on the trapezium. Its divided attachment to the trapezium forms a tunnel, lined by synovial membrane, which transmits the tendon of the flexor carpi radialis (fig. 43)

Internally it is attached to the pisiform and the hook of the unciform. The outer and inner extremities give attachment to the short muscles of the thumb and little finger (Plate XI).

RELATIONS OF THE ANNULAR LIGAMENT.—On the *superficial surface* of the ligament the palmaris longus passes to join the palmar fascia. The tendon and fascia are bound to the ligament. The ulnar artery and nerve also pass superficially at its inner attachment (fig. 43). In the superficial fascia over it are the palmar cutaneous branches of the ulnar and median nerves. The superficialis volæ crosses the short muscles of the

thumb beyond its outer attachment.

FIG. 43.—SECTION OF THE ANNULAR LIGAMENT AND CARPUS. (Henle.)



1. Ulnar vessels. 2. Ulnar nerve. 3. Canal for flexors sublimis and profundus digitorum and flexor longus pollicis, and median nerve. 4. Tendon of palmaris longus on anterior annular ligament. 5. Semilunar bone. 6. Sheath for flexor carpi radialis. 7. Radial origin of annular ligament. 8. Sheath for extensor ossis metacarpi and primi internodii pollicis. 9. Radial vessels. 10. Outer part of posterior annular ligament. 11. Os magnum. 12. Sheath of extensor secundi internodii pollicis. 13. Scaphoid. 14. Sheath of extensor carpi radialis, longior and brevior. 15. Sheath of extensor communis and indicator. 16. Semilunar. 17. Unciform. 18, 21. Cuneiform. 19. Sheath of extensor minimi digiti. 20. Sheath of extensor carpi ulnaris. 22. Pisiform.

Beneath the ligament the following structures will be seen (Plate XI):

(1) The median nerve; (2) tendons of the flexor longus pollicis; (3) of the flexor sublimis digitorum; (4) of the flexor profundus digitorum; (5) synovial sheaths surrounding these tendons (fig. 34); (6) the tendon of the flexor carpi radialis passes under the upper border of the ligament and

downwards between the attachments of the ligament to the trapezium.

THE ANTERIOR CARPAL PLEXUS.—In the front of the carpus, beneath the flexor tendons, will be found an arterial plexus formed by branches of the deep palmar arch and of the anterior carpal arch. The anterior interosseous nerve also terminates in the ligaments of the carpus, beneath the flexor tendons.

THE SYNOVIAL SHEATHS OF THE FLEXOR TENDONS AT THE WRIST.—The anterior annular ligament is now to be divided from its upper to its lower border in the middle line of the wrist. It is extremely thick and resistant. When the flexor tendons are thus exposed they are found surrounded

by a complicated membranous synovial sac (figs. 34 and 38). If the sac is distended with fluid, as it is sometimes from sprain or overwork, it is found to protrude and swell above and below the ligament. When cut into, it will be seen that each tendon, as it passes through the sac, receives a covering of synovial membrane and is suspended by a mesentery. If the sac is inflamed, the tendons become bound together and to the sac.

There are two sheaths beneath the anterior annular ligament. A narrow one encloses the tendon of the flexor longus pollicis; a large and loose sheath encloses the tendons of the deep and superficial flexors (fig. 38).

These sheaths vary in their extent; that of the flexor longus pollicis extends into the thumb, and may communicate with the larger sheath beneath the anterior annular ligament.

The large sheath of the flexors of the fingers sends processes downwards into the palm. The innermost palmar process is continuous with the synovial sheath in the little finger (fig. 38). The other processes extend into the palm, *towards* the index, middle and ring fingers, but do not communicate with the synovial flexor sheaths of those digits.

It will thus be seen that, while there is an open synovial channel from the little finger and thumb to the synovial sheaths at the wrist, there is, as a rule, no such communication between the other digits and the wrist. The synovial channels offer an easy means for the spread of suppuration.

The Flexor Tendons in the Palm and Fingers.—The student is now to examine the passage of the flexor tendons through the palm, and the manner in which they terminate in the fingers. For this purpose the superficial structures must be cleared away. The superficial palmar arch is to be divided at each side of the palm and removed with the digital vessels. The digital nerves must also be cut away. The palmar fascia should be detached now, if not already cut away. Note the four lumbrical (worm-like) muscles rising between the deep tendons in the palm (Plate X). At the metacarpo-phalangeal joint, the two flexor tendons for each finger enter a strong fibrous sheath, which, with the flexor surfaces of the phalanges, forms a tunnel for the tendons. These fibrous sheaths must now be carefully cleaned.

The Vaginal Ligaments (Plates X and XI).—On the palmar surface of each finger the two flexor tendons are kept in

PLATE XI.

SUPERFICIAL PALMAR ARCH, ULNAR AND MEDIAN NERVES.

Arteries.

- A. Ulnar.
- B. Radial.
- C. Superficial palmar arch.
- D. Superficialis volæ.
- E. Princeps indicis.
- F. Digital.

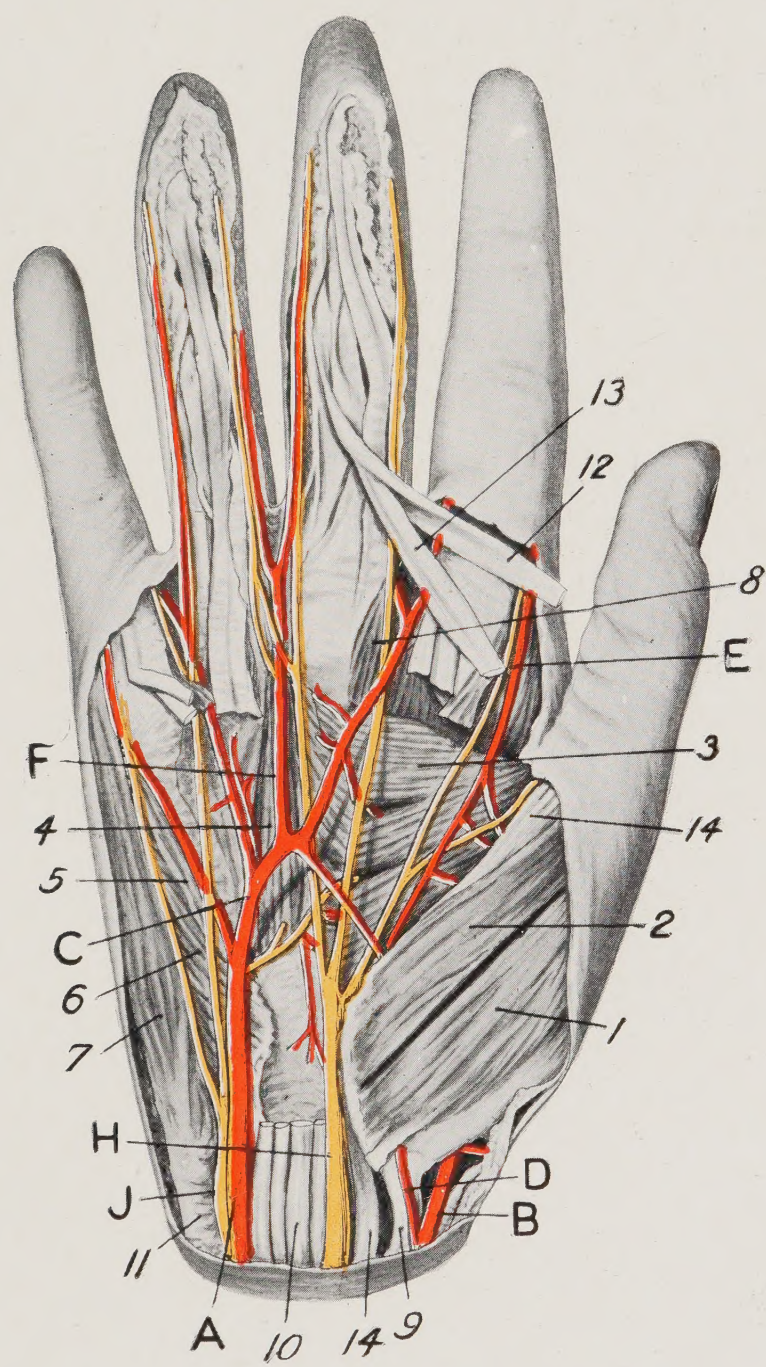
Nerves

- H. Median.
- J. Ulnar.

Muscles and Tendons.

- 1. Abductor pollicis.
- 2. Flexor brevis pollicis (radial head).
- 3. Adductor transversus pollicis.
- 4. Second palmar interosseus.
- 5. Flexor brevis minimi digiti
- 6. Opponens minimi digiti.
- 7. Abductor minimi digiti.
- 8. Second lumbrical.
- 9. Flexor carpi radialis.
- 10. Flexor tendons.
- 11. Flexor carpi ulnaris.
- 12. Flexor sublimis digitorum.
- 13. Flexor profundus digitorum.
- 14. Flexor longus pollicis.

PLATE XI.



position by a fibrous sheath or theca (figs. 40 and 42), the ligamentum vaginale, which extends from the metacarpophalangeal joint to the base of the terminal phalanx. The sheath is attached to a ridge on the lateral margins of each phalanx, a tunnel being thus formed, the floor of which is the flattened anterior surface of the phalanx. The sheath is very thick, dense, and fibrous opposite the phalanges, but very thin opposite the inter-phalangeal joints (fig. 56). This can be seen by laying open a sheath and exposing the tendons. The structures which lie superficial to the vaginal sheath are shown in figure 40. The student will readily understand that an injury which exposes the synovial sheaths of the flexor tendons is much more serious than one which stops short of the outer surface of the vaginal ligament. A synovial membrane lines the sheath and also forms a tubular covering for the enclosed tendons. Notice that these two parts of the synovial membrane (thecal and tendinous) are continuous at the superior and inferior limits of the sheath.

When the flexor tendons are lifted from the phalanges, folds of synovial membrane are seen to bind the terminal parts of the tendons to the phalanges. Through these folds the vessels pass to nourish the tendons. The folds are known as *vincula accessoria*. Those filling the angle between the tendon and phalanx are the *ligamenta brevia*; the longer separate slips are the *ligamenta longa*. The long ligaments contain yellow elastic tissue.

Insertions of the Flexor Tendons (fig. 42).—The tendon of the *flexor sublimis* (perforatus) will be seen to split in front of the proximal phalanx, and allow the passage of the tendon of the flexor profundus (perforans). The two divisions of the flexor sublimis are partially united underneath the perforating tendon, but separate again into two bundles which are inserted into the sides of the middle phalanx (Plates XI and XV).

The tendon of the flexor profundus is inserted into the base of the terminal phalanx.

Lumbrical Muscles.—These four small fusiform muscles arise from the tendons of the flexor profundus in the palm. They terminate in thin tendons which wind round the radial side of each finger to be inserted into the outer part of the expansion of the extensor tendon on the dorsal aspect of the first phalanx (figs. 42 and 48). The two outermost arise

each from single tendons, the two inner ones arise from the adjacent sides of two tendons.

NERVE SUPPLY.—The lumbrical muscles for the index and middle fingers are supplied from the corresponding digital branches of the median nerve. Those of the ring and small fingers are supplied from the deep branch of the ulnar.

ACTION.—Note first their movable origin from the deep flexor tendons. This permits them to still act vigorously when the fingers are flexed by these tendons. They cross and therefore flex the metacarpo-phalangeal (knuckle) joints. Through their insertion to the extensor tendons they extend the middle and distal phalanges.

Short Muscles of the Little Finger (Plates X and XI).—These short muscles, three in number, will be found under the hypothenar eminence. Superficially are the (1) *flexor brevis*, and (2) *abductor minimi digiti*, the latter being to the inner side; beneath these two will be found (3) the *opponens minimi digiti*.

(1) *Abductor Minimi Digiti*.—**ORIGIN.** From the pisiform bone and tendon of the flexor carpi ulnaris.

INSERTION.—To the inner side of base of the proximal phalanx of little finger.

(2) *Flexor Brevis Minimi Digiti*.—**ORIGIN.** From the hook of the unciform and anterior annular ligament.

INSERTION.—The same as the abductor.

(3) *Opponens Minimi Digiti*.—**ORIGIN.** The same as the flexor brevis.

INSERTION.—To the whole length of the shaft of the fifth metacarpal bone on its inner border.

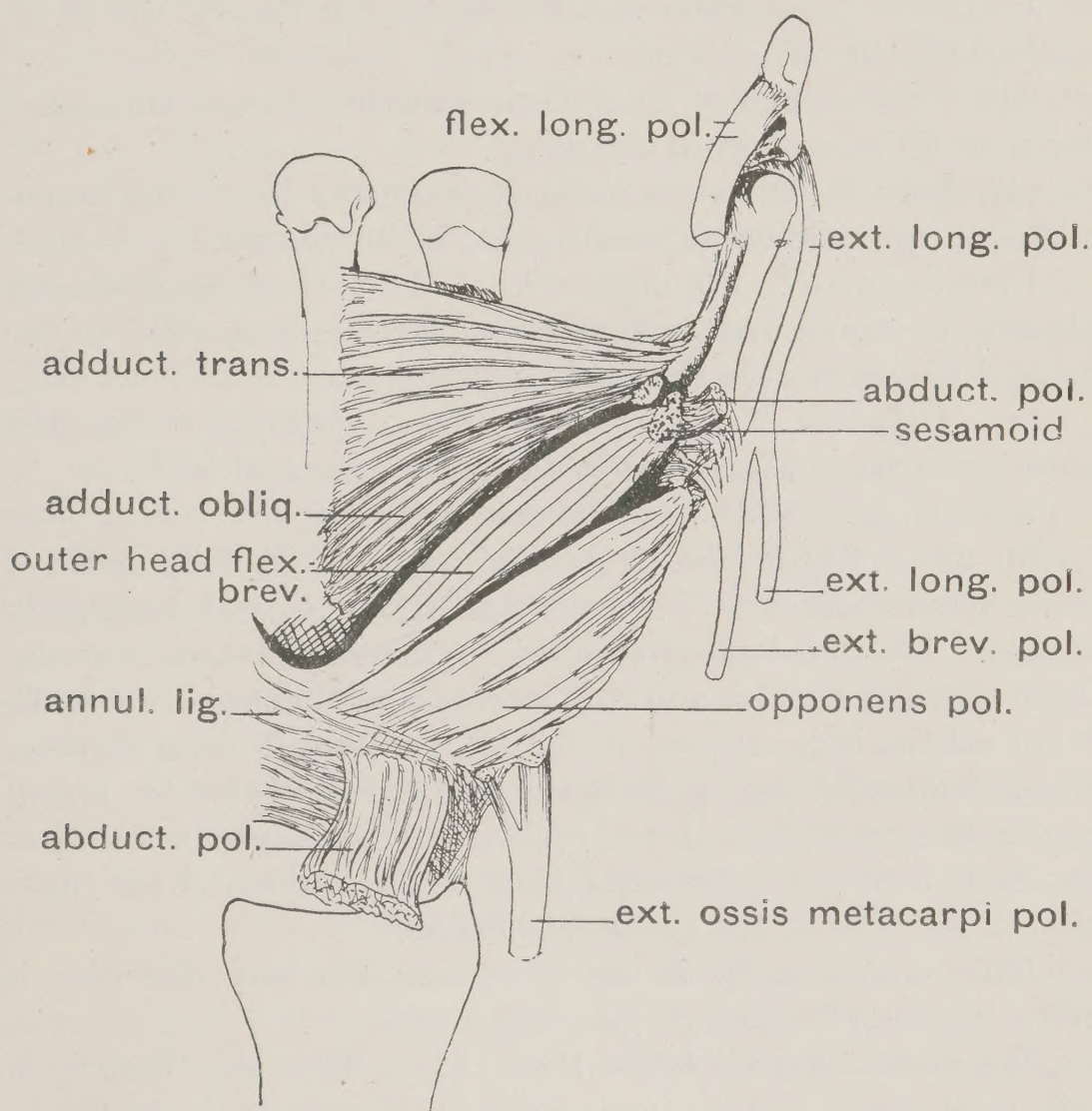
NERVE SUPPLY.—All three muscles are supplied from the deep division of the ulnar nerve (fig. 36). The deep ulnar dips into the palm between the flexor brevis and abductor; it perforates the fibres of the opponens.

Short Muscles of the Thumb (Plate XI and fig. 44).—Difficulty may be experienced in separating and recognising these muscles. Six muscles should be present; three of them are inserted to the outer border of the thumb, and three on the inner border. Some of these may be fused together, or, on the other hand, one or more of them may be separated into two or more parts.

The most superficial muscle on the thenar eminence is

(1) the *abductor pollicis*; to the inner side of this will be found (2) the *outer flexor brevis pollicis*. It lies to the outer side of the tendon of the flexor longus pollicis. By separating the abductor from the flexor brevis (3) the *opponens* will be seen (fig. 44). To the inner side of the long flexor tendon will be found (4) the *adductor obliquus*, and, passing trans-

FIG. 44.—THE MUSCLES OF THE THUMB.



versely towards the thumb from the middle of the palm, will be seen (5) the *adductor transversus*. On the deep (dorsal) aspect of the adductor obliquus will be found (6) the *inner flexor brevis pollicis*. It is small and may be absent.

(1) *Abductor Pollicis*.—ORIGIN. From the tubercle of the scaphoid, ridge of trapezium, and anterior annular ligament.

INSERTION.—To the outer side of the base of the proximal

phalanx of the thumb. A sesamoid bone is imbedded in the glenoid ligament near the point of insertion.

(2) *Outer Flexor Brevis Pollicis*.—ORIGIN. From the ridge of trapezium and annular ligament.

INSERTION.—With the abductor pollicis to the radial border of the basal phalanx.

(3) *Opponens Pollicis*.—ORIGIN. From the ridge of trapezium and annular ligament.

INSERTION.—To the outer border and surface of the shaft of the 1st metacarpal bone.

The *nerve supply* of these three muscles is from the outer division of the median in the palm.

(4) *Adductor Obliquus Pollicis*.—ORIGIN. From the trapezoid, os magnum, and bases of the 2nd and 3rd metacarpal bones.

INSERTION.—To the inner side of the base of the proximal phalanx of the thumb. A sesamoid bone is imbedded in the glenoid ligament near the point of insertion.

(5) *Adductor Transversus Pollicis*.—ORIGIN. From the anterior surface of the shaft of the 3rd metacarpal bone.

INSERTION.—With the adductor obliquus.

(6) *Inner Flexor Brevis Pollicis*. (Inner or deep head of flexor brevis pollicis.)—If present it is small; it is frequently absent. It is most easily exposed on the dorsal aspect of the hand between the 1st and 2nd metacarpal bones. It will be found on the inner aspect of the 1st metacarpal bone between the adductor obliquus pollicis and outer head of the 1st dorsal interosseous muscle. It *rises* from the ligamentous tissue at the base of the 1st metacarpal bone, and is *inserted* to the inner side of the base of the proximal phalanx.

The *nerve supply* of the three muscles last described is from the deep division of the ulnar nerve.

The Deep Palmar Arch (Plate XI).—The deep branch of the ulnar artery and nerve should now be traced in the palm. The *deep palmar arch* with its branches is to be dissected out and defined. To expose this arch fully it is necessary to reflect the adductor transversus and part of the adductor obliquus. The termination of the radial artery will be found entering the palm between the metacarpal bones of the thumb and index finger (Plate XIII). The deep palmar arch is formed by the termination of the radial artery in the palm, and its junction with the deep branch of the ulnar artery.

RELATIONS (Plate XI).—*Superficial* to it pass the flexor tendons and the lumbrical muscles, branches of the median nerve, part of the adductors of the thumb, and the flexor brevis minimi digiti. *Deep* to it are the bases of the metacarpal bones and interosseous muscles. It is accompanied by the deep branch of the ulnar nerve.

The deep arch is about a finger's breadth nearer the wrist than the superficial arch (see fig. 39).

Branches of the Deep Palmar Arch.—(1) The *palmar interosseous branches*, three in number, lie on the palmar interosseous muscles of the three inner spaces. Near the clefts of the fingers they end by anastomosing with the digital branches of the superficial palmar arch. Each sends also an *anterior perforating branch* to the dorsal interosseous artery of the same space.

(2) The *posterior perforating branches*, three in number, pass backwards between the metacarpal bones to join the dorsal interosseous arteries.

(3) The *recurrent branches* pass upwards on the carpus and anastomose with branches of the anterior carpal arch.

Branches of the Radial Artery in the Palm (Plate XI).—Two branches are given off from the radial artery in the palm, previous to its junction with the deep branch of the ulnar to form the deep palmar arch. These are (1) the princeps pollicis and (2) radialis indicis.

(1) The *princeps pollicis* is given off just after the radial has pierced the abductor indicis (first dorsal interosseous) and entered the palm. It divides into two branches, which are distributed to the sides of the thumb.

(2) The *radialis indicis*, given off close to the preceding branch, passes along the outer side of the index finger. The distribution of these two arteries is similar to that of the digital arteries.

The **deep branch of the Ulnar Nerve** accompanies the deep branch of the ulnar artery, between the abductor and flexor brevis minimi digiti. It crosses the palm with the deep palmar arch. It supplies branches: (1) to the three short muscles of the little finger, (2) to all the interosseous muscles, (3) to the two inner lumbrical muscles, (4) to the adductor transversus and adductor obliquus pollicis and inner head of the flexor brevis pollicis.

DISSECTION X

EXTENSOR SURFACE OF FOREARM AND HAND

Surface Markings.—Before commencing this dissection, the student should examine the following points in his own hand and wrist:—

1. The *styloid process of the ulna*. When the hand is pronated the rounded lower extremity of the ulna protrudes on the dorsal and inner aspect of the wrist. The styloid process will be felt projecting from the anterior and inner side of its extremity. The tendon of the extensor carpi ulnaris can be felt on the dorsal aspect of the process.

2. The *styloid process of the radius* projects downwards half an inch lower at the outer border of the wrist. Two tendons cross the process and proceed to the thumb. They are the extensor ossis metacarpi pollicis and extensor brevis pollicis.

3. The tendon of the *extensor longus pollicis* becomes prominent towards the outer side of the wrist when the thumb is extended. This tendon, with the two tendons for the thumb mentioned above, bounds the ‘anatomical snuffbox.’ The radial artery passes in the floor of this recess as it winds from the palmar to the dorsal aspect of the wrist.

4. The *posterior border of the ulna* can be traced beneath the skin. It terminates above in the olecranon.

The Nails.—The student should not omit to examine the manner in which the nails are fixed to the fingers. They cover and are bound to the terminal parts of the distal (ungual) phalanges; they support the pulp of the finger-tips. He should observe:

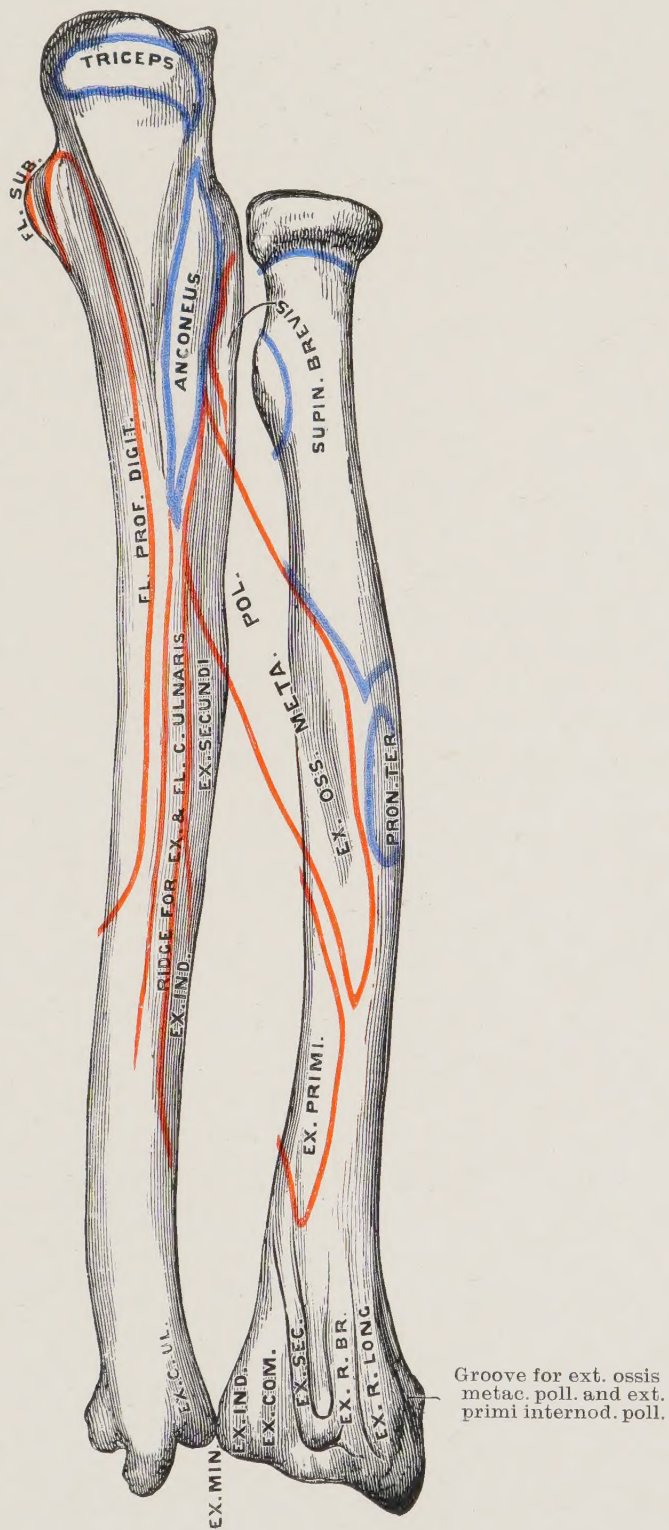
1. The *nail-root*. The white crescentic *lunule* at the base marks the root during life. The nail is formed by the growth of the epithelium which covers the papillæ of the nail-root.

2. The *nail-bed*. When the nail is plucked off with the forceps, the nail-bed is seen to be grooved; it is made up of papillæ arranged in lines from the root to the tip of the nail. The papillæ are richly supplied with nerves and vessels.

3. The *nail-fold* surrounds and overhangs the basal part of

PLATE XII.

THE MUSCULAR ATTACHMENTS ON THE EXTENSOR ASPECT
OF THE RADIUS AND ULNA. (*After Holden.*)



the nail. The corneous layer of the epidermis ceases at the nail-fold, the stratum lucidum forming the superficial layer of the nail.

Cutaneous Nerves on the Back of the Hand.

of the Hand.—The hand and forearm are now to be fixed to the dissecting-board, so as to expose the extensor aspect of the forearm and hand. The skin is to be removed from the back of the hand, thumb, and fingers. Two nerves are now to be traced to their terminations:—

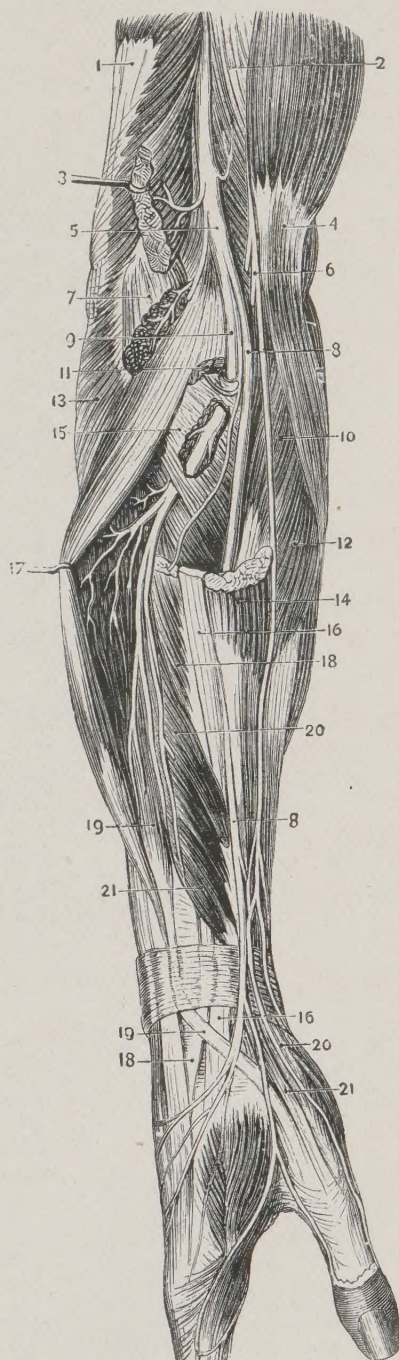
1. The Dorsal Branch of the Ulnar.

2. The Radial.

1. The *Dorsal Branch of the Ulnar Nerve* (fig. 22 and Plate XIII) will be seen above the wrist passing over the extensor carpi ulnaris. It divides into three or four branches. One passes to the inner border of the little finger; a second passes to supply the adjacent sides of the little and ring fingers; the remaining twigs communicate with the radial nerve on the dorsum of the hand and in the cleft between the ring and middle fingers.

2. The *Radial Nerve* (fig. 45), one of the terminal branches of the musculo-spiral nerve, reaches the dorsum by passing beneath the tendon of the supinator longus about three inches above the wrist. It divides into branches to supply the sides of the thumb, index, middle and outer side of the ring fingers,

FIG. 45.—THE TERMINATION OF THE MUSCULO-SPIRAL AND MUSCULO-CUTANEOUS NERVES. (*Hirschfeld and Leveillé.*)



1. Triceps. 2. Brachialis anticus. 3. Supinator longus. 4. Biceps. 5. Musculo-spiral nerve. 6. Musculo-cutaneous nerve. 7. Origin of extensor carpi radialis longior. 8, 8. Radial nerve. 9. Posterior interosseous nerve. 10. Pronator radii teres. 11. Origin of extensor carpi radialis brevior. 12. Flexor carpi radialis. 13. Anconeus. 14. Tendon of supinator longus. 15. Supinator brevis. 16, 16. Tendon of extensor carpi radialis longior. 17. Extensor communis digitorum. 18, 18. Tendon of extensor carpi radialis brevior. 19, 19. Extensor secundi internodii pollicis. 20, 20. Extensor ossis metacarpi pollicis. 21, 21. Extensor primi internodii pollicis.

PLATE XIII.

DISSECTION OF THE EXTENSOR ASPECT OF THE FOREARM.

Muscles.

- A. Anconeus.
- B. Supinator brevis.
- C. Extensor carpi radialis longior.
- D. Extensor carpi radialis brevior.
- E. Extensor minimi digiti.
- F. Extensor carpi ulnaris.
- G. Extensor communis digitorum.
- H. Extensor longus pollicis.
- I. Extensor ossis metacarpi pollicis.
- J. Extensor brevis pollicis.
- K. Extensor indicis.
- L. First dorsal interosseus.
- M. Posterior annular ligament.

Arteries.

- 1. Posterior interosseus.
- 2. Terminal branch of anterior interosseus.
- 3. Radial on the wrist.
- 4. First dorsal interosseus.
- 5. Dorsalis indicis.

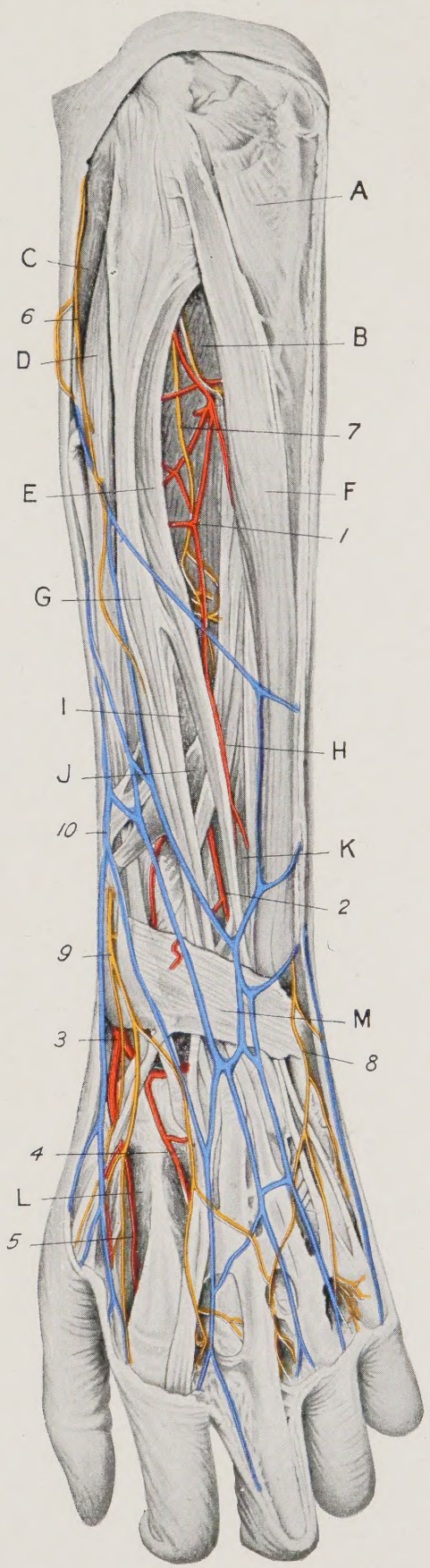
Nerves.

- 6. External cutaneous of musculo-spiral.
- 7. Posterior interosseus.
- 8. Dorsal branch of ulnar.
- 9. Radial.

Vein.

- 10. Radial.

PLATE XIII.



communicating also with the dorsal branch of the ulnar nerve.

Deep Fascia.—The deep fascia is thick and strong on the posterior surface of the forearm, especially in its upper half, where it is attached to the posterior border of the ulna and gives origin on its deep surface to the extensor muscles. The white lines seen on its surface mark the intermuscular septa. At the back of the wrist it is especially thickened by a band of oblique fibres which form the *posterior annular ligament* (Plate XIII). This is attached externally to the outer border of the lower end of the radius. It passes inwards and downwards to terminate on the dorsal aspect of the cuneiform bone and the inner border of the carpus. The ligament bridges over the tendon grooves on the dorsal aspect of the lower extremity of the radius and ulna. Each groove is lined by a synovial sheath. The inflammation that follows a fracture of the lower extremity of the radius frequently leads to adhesion of the tendons to their sheaths. They cannot be extended until the adhesions are broken down.

Muscles of the Back of the Forearm.—The upper and lower borders of the posterior annular ligament are to be defined. The deep fascia is to be removed as muscle after muscle is made out. There are two groups of extensor muscles—Superficial and Deep.

The muscles of the superficial group may best be recognised by commencing on the outer side. They will be found in the following order (fig. 46):—1. Supinator radii longus (already dissected); 2. Extensor carpi radialis longior; 3. Extensor carpi radialis brevior (1, 2, and 3 overlap each other from without inwards); 4. Extensor communis digitorum; 5. Extensor minimi digiti; 6. Extensor carpi ulnaris; 7. The anconeus, which lies just below the elbow and is hidden from view by a strong fascia prolonged downwards from the triceps (fig. 47).

(1) **Supinator Radii Longus** (fig. 45) has been already described (p. 77).

(2) **Extensor Carpi Radialis Longior.**—**ORIGIN.** (1) Lower third of the external supra-condyloid ridge of the humerus; (2) the external intermuscular septum; and (3) the common tendon of origin from the external condyle.

INSERTION.—Into the dorsal surface of the base of the second metacarpal bone, near its radial border.

FIG. 46.—THE SUPERFICIAL LAYER OF EXTENSOR MUSCLES OF THE FOREARM. (Wilson.)



1. Biceps. 2. Brachialis anticus. 3. Lower part of the triceps, inserted into the olecranon. 4. Supinator longus. 5. Extensor carpi radialis longior. 6. Extensor carpi radialis brevior. 7. Tendons of insertion of these two muscles. 8. Extensor communis digitorum. 9. Extensor minimi digiti. 10. Extensor carpi ulnaris. 11. Anconeus. 12. Flexor carpi ulnaris. 13. Extensor ossis metacarpi and extensor primi interodii lying together. 14. Extensor secundi interodii; its tendon is seen crossing the tendons of the extensor carpi radialis longior and brevior. 15. Posterior annular ligament. The tendons of the common extensor are seen on the back of the hand, and their mode of distribution on the dorsum of the fingers.

NERVE SUPPLY.—From the musculospiral.

ACTION.—It flexes the elbow and extends the wrist-joint.

(3) **Extensor Carpi Radialis Brevior.**—

ORIGIN. (1) By the common extensor tendon from the external condyle of the humerus; (2) the external lateral ligament; (3) the fascia which covers the muscle; and (4) septa which separate it from the adjacent muscles.

INSERTION.—Into the dorsal surface of the base of the third metacarpal bone on its radial side.

NERVE SUPPLY.—The posterior interosseous nerve, which passes beneath it at the elbow (fig. 45).

ACTION.—It extends both the elbow and wrist joints.

(4) **Extensor Communis Digitorum**

(Plate XIII).—ORIGIN. (1) By the common tendon from external condyle; (2) from the deep fascia, and (3) intermuscular septa.

INSERTION.—A little above the wrist four tendons are formed which pass under the annular ligament to the dorsum of the hand. The tendons lie in a groove on the lower extremity of the radius. These tendons are inserted into the middle and distal phalanges of the four fingers.

THE TERMINATION OF THE EXTENSOR TENDONS ON THE FINGERS (fig. 48).—Over the knuckle-joints (metacarpophalangeal) each tendon spreads out to form a *dorsal membranous expansion*. The tendons of the lumbrical and interosseous muscles join the dorsal expansion over the proximal phalanx (fig. 42). Over the first inter-phalangeal joint this

expansion divides into *three*; the *central part* is inserted into the base of the middle phalanx, while the *lateral parts* unite into a single band which is inserted into the base of the terminal phalanx.

NERVE SUPPLY.—The *posterior interosseous* which, with the posterior interosseous artery, passes downwards beneath the muscle (fig. 45).

ACTION.—The muscle extends (1) the inter-phalangeal joints, (2) the metacarpo-phalangeal joints, (3) the wrist-joint, (4) the elbow-joint.

(5) **Extensor Minimi Digiti** (Plate XIII).—ORIGIN. From (1) the external condyle by the common tendon, (2) deep fascia, and (3) intermuscular septa.

INSERTION.—It joins the membranous expansion on the little finger formed by the fourth tendon of the extensor communis. It commonly sends a slip to this tendon on the carpus. The tendon occupies a separate compartment under the annular ligament, between the ulna and radius.

(6) **Extensor Carpi Ulnaris** (Plate XIII).—ORIGIN. From (1) the common tendon, (2) intermuscular septa, (3) fascia of the forearm, and by (4) an aponeurosis from the posterior border of the ulna (Plate XII).

INSERTION.—Inner side of the base of the metacarpal bone of the little finger.

NERVE SUPPLY.—From the posterior interosseous.

ACTION.—It extends and adducts the wrist-joint; it assists also in extending the elbow.

(7) **Anconeus** (Plate XIII).—To see this muscle it is necessary to remove a strong layer of fascia which extends down on its surface from the triceps. It occupies the interval between the lower part of the triceps and upper border of the extensor carpi ulnaris.

ORIGIN.—From the back of the external condyle, where it is in contact with the inner head of the triceps.

INSERTION.—Into a triangular area at the upper part of the posterior surface of the ulna (Plate XII).

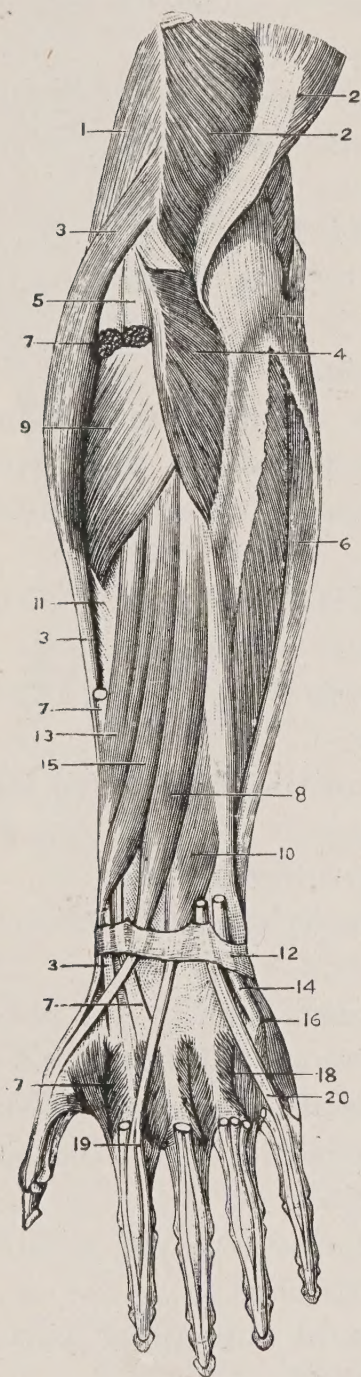
NERVE SUPPLY.—By a branch of the musculo-spiral which passes through the inner head of the triceps to reach it.

ACTION.—It extends the elbow.

When the muscle is detached it will be found to cover the

posterior interosseous recurrent artery and the posterior part of the capsule of the elbow-joint.

FIG. 47.—THE DEEP EXTENSOR LAYER OF MUSCLES OF THE FOREARM. (*Sappey.*)



1. Supinator longus. 2, 2, Triceps.

3, 3, 3. Extensor carpi radialis

longior. 4. Anconeus. 5. Common tendon of extensor communis digitorum, extensor minimi

digiti, and extensor carpi ulnaris. 6. Flexor carpi ulnaris, turned aside from flexor profundus

digitorum. 7, 7, 7. Extensor carpi radialis brevior. 8. Extensor secundi internodii pollicis.

9. Supinator brevis. 10. Extensor indicis. 11. Insertion of pronator radii teres. 12. Posterior

annular ligament. 13. Extensor ossis metacarpi pollicis. 14. Insertion of extensor carpi

ulnaris. 15. Extensor primi internodii pollicis. 16. Abductor minimi digiti. 17. Abductor

indicis. 18. Dorsal interosseous of fourth interspace. 19. Expansion of extensor communis

digitorum and tendon of extensor indicis. 20. Tendon of extensor minimi digiti about to

blend with tendon of extensor communis digitorum.

Structures beneath the superficial layer of muscles (Plate XII).—One by one the seven superficial muscles just described are to be detached at their origin and thrown downwards; the posterior interosseous nerve and vessels will be found beneath them. The deep layer of muscles, then exposed, are five in number, and are arranged from without inwards in the following order (fig. 47):

(1) Supinator brevis, embracing the upper third of the radius.

(2) The extensor ossis metacarpi pollicis.

(3) The extensor brevis pollicis.

(4) The extensor longus pollicis.

(5) The extensor indicis.

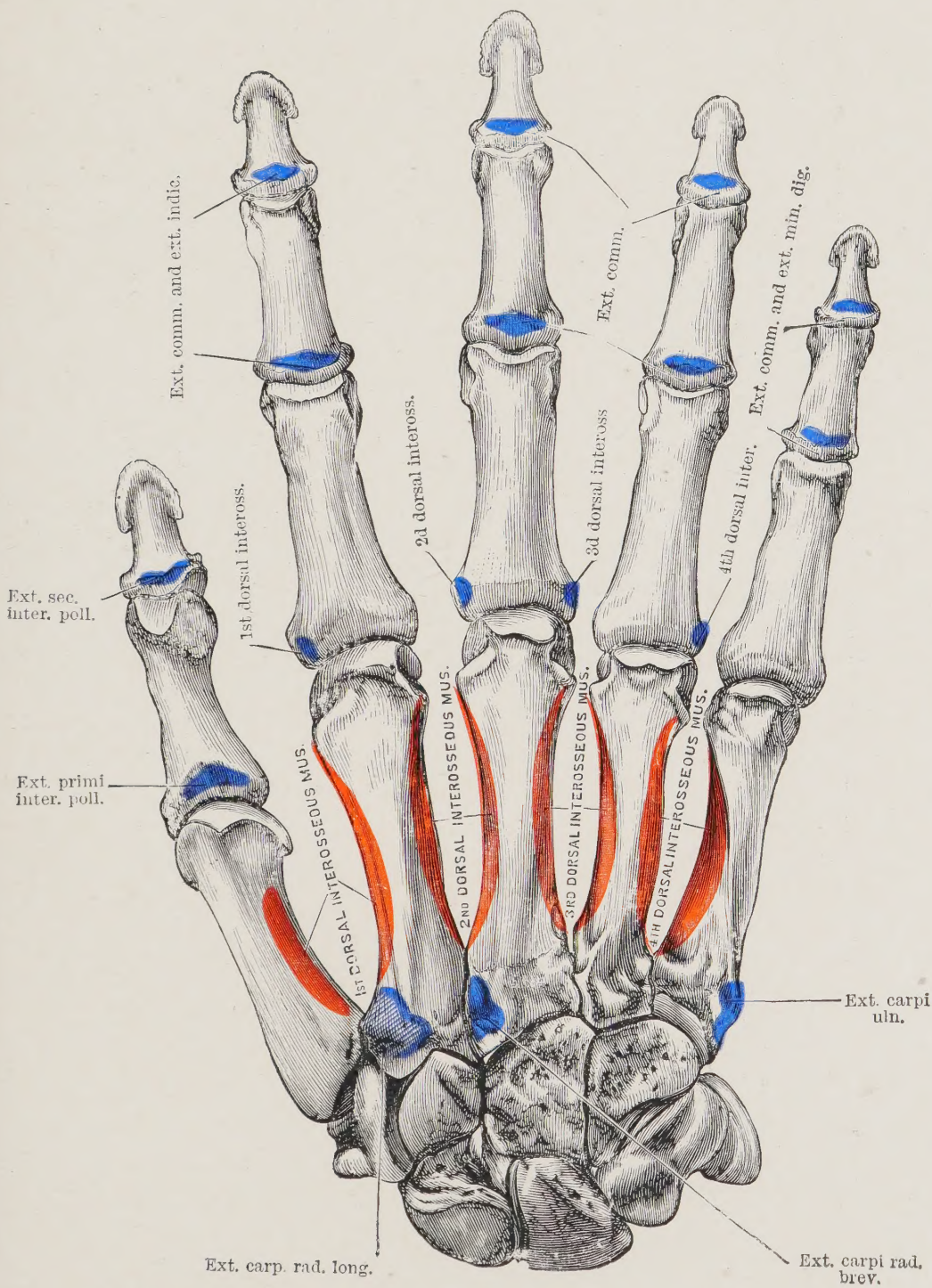
Piercing the supinator brevis will be found the posterior interosseous nerve.

Posterior Interosseous Nerve.—

This nerve is one of the terminal branches of the musculo-spiral (fig. 45). From the front of the external condyle it winds obliquely round the upper end of the radius, passing through the supinator brevis muscle. Having reached the back of the forearm it passes downwards between the superficial and deep muscles with the accompanying artery, and, having supplied twigs to these

PLATE XIV

THE MUSCULAR ATTACHMENTS ON THE DORSAL ASPECT
OF THE HAND. (*After Holden.*)



muscles, it dips underneath the extensor longus pollicis, to reach the surface of the interosseous membrane. There it comes in contact with the terminal part of the anterior interosseous artery, which passes backwards between the radius and ulna. It then passes down beneath the posterior annular ligament, and, having reached the back of the carpus, terminates in a gangliform enlargement, from which articular filaments are given off to the carpal joints.

BRANCHES.—(1) Terminal articular carpal branches.

(2) Muscular twigs to all the extensor muscles of the forearm with the exception of the supinator longus and extensor carpi radialis longior, which are supplied from the musculo-spiral.

Posterior Interosseous Artery (Plate XIII).—The adjoining borders of the supinator brevis and extensor ossis metacarpi pollicis must be separated so as to trace the artery to the anticubital space. Its origin in this space requires careful dissection.

This is the larger of the two branches from the common interosseous branch of the ulnar artery (figs. 29 and 53). It passes back between the radius and ulna, above the interosseous membrane and below the oblique ligament, and appears on the dorsal surface of the forearm at the lower border of the supinator brevis. Here it gives off the interosseous recurrent branch and divides into numerous muscular branches to supply the superficial and deep muscles. Its terminal branch anastomoses at the wrist with the terminal branch of the anterior interosseous artery.

The *posterior interosseous recurrent* artery passes upwards beneath the anconeus and in the interval between the internal condyle and olecranon to anastomose with the posterior branch of the superior profunda and end in the periarticular plexus of the elbow-joint.

Periarticular Plexus of the Elbow-joint (figs. 28 and 29, p. 68).—The following arteries have now been seen to enter into this plexus or anastomosis :

(1) The superior profunda. Its anterior and posterior terminal branches reach the elbow-joint in front of and behind the external intermuscular septum.

(2) The inferior profunda terminates behind the internal condyle.

(3) The *anastomotica magna* ends around the internal condyle.

(4) The posterior interosseous recurrent joins the posterior terminal branch of the superior profunda.

(5) The radial recurrent joins the anterior terminal branch of the superior profunda.

(6) The anterior ulnar recurrent joins the *anastomotica*.

(7) The posterior ulnar recurrent joins the inferior profunda. A transverse arch, above the olecranon process, joins the anastomosis on the outer side to that of the inner side of the joint.

The periarticular plexus assures a sufficient blood supply to both elbow and forearm, in all positions of the elbow-joint.

Deep Muscles of the Back of the Forearm:

(1) **Supinator brevis** (fig. 47 and Plate XII).—ORIGIN. From (1) the external condyle of the humerus; (2) external lateral ligament; (3) orbicular ligament; and from (4) a ridge and triangular depression below the lesser sigmoid cavity of the ulna.

INSERTION.—The muscle fibres pass obliquely outwards and downwards, winding round the upper third of the radius. They are inserted into the outer and anterior surfaces of the bone, extending downwards in front as far as the oblique line.

NERVE SUPPLY.—The posterior interosseous nerve, which perforates the muscle, dividing it into a superficial and deep lamina (fig. 45).

ACTION.—It is by far the most powerful supinator of the forearm and hand. It also serves to bind the radius in the elbow-joint.

(2) **Extensor Ossis Metacarpi Pollicis** (fig. 47 and Plate XII).—ORIGIN. From the posterior surfaces of the ulna and radius, below the attachments of the *anconeus* and *supinator brevis*.

INSERTION.—Into the base of the first metacarpal bone on its outer side (fig. 44). A slip passes to the trapezium or fibrous tissue over the trapezium.

NERVE SUPPLY.—Posterior interosseous.

ACTION.—It extends and abducts the thumb; it may also abduct the hand at the wrist.

(3) **Extensor Brevis Pollicis** (*Primi Internodii Pollicis*) (fig. 47).—ORIGIN. Posterior surface of the radius below the *extensor ossis metacarpi pollicis* and from the interosseous membrane.

INSERTION.—Into the base of the proximal phalanx of the thumb (fig. 44). The tendon may be partially conjoined with that of the last.

NERVE SUPPLY.—The posterior interosseous.

ACTION.—It extends the proximal phalanx and abducts the thumb and wrist.

The tendons of the two muscles just described pass in a common synovial compartment on the outer side of the lower extremity of the radius.

(4) **Extensor Longus Pollicis** (*Secundi Internodii Pollicis*) (fig. 47).—ORIGIN. From the posterior surface of the ulna below the extensor ossis metacarpi pollicis and from the interosseous membrane.

INSERTION.—Into the base of the terminal phalanx of the thumb (fig. 44).

NERVE SUPPLY.—Posterior interosseous.

ACTION.—It extends the terminal phalanx and abducts the thumb.

The tendon occupies a narrow deep groove on the extremity of the radius. If the thumb be extended it will be seen that the tendon, which then becomes very prominent, would slip outwards on the wrist, were its synovial groove not bounded externally by a very prominent ridge.

(5) **Extensor Indicis** (fig. 47).—ORIGIN. From the posterior surface of the ulna below the extensor secundi internodii pollicis, and from the interosseous membrane.

INSERTION.—Into the aponeurotic expansion of the common extensor tendon on the index finger.

NERVE SUPPLY.—Posterior interosseous.

ACTION.—It serves as an additional extensor of the index finger.

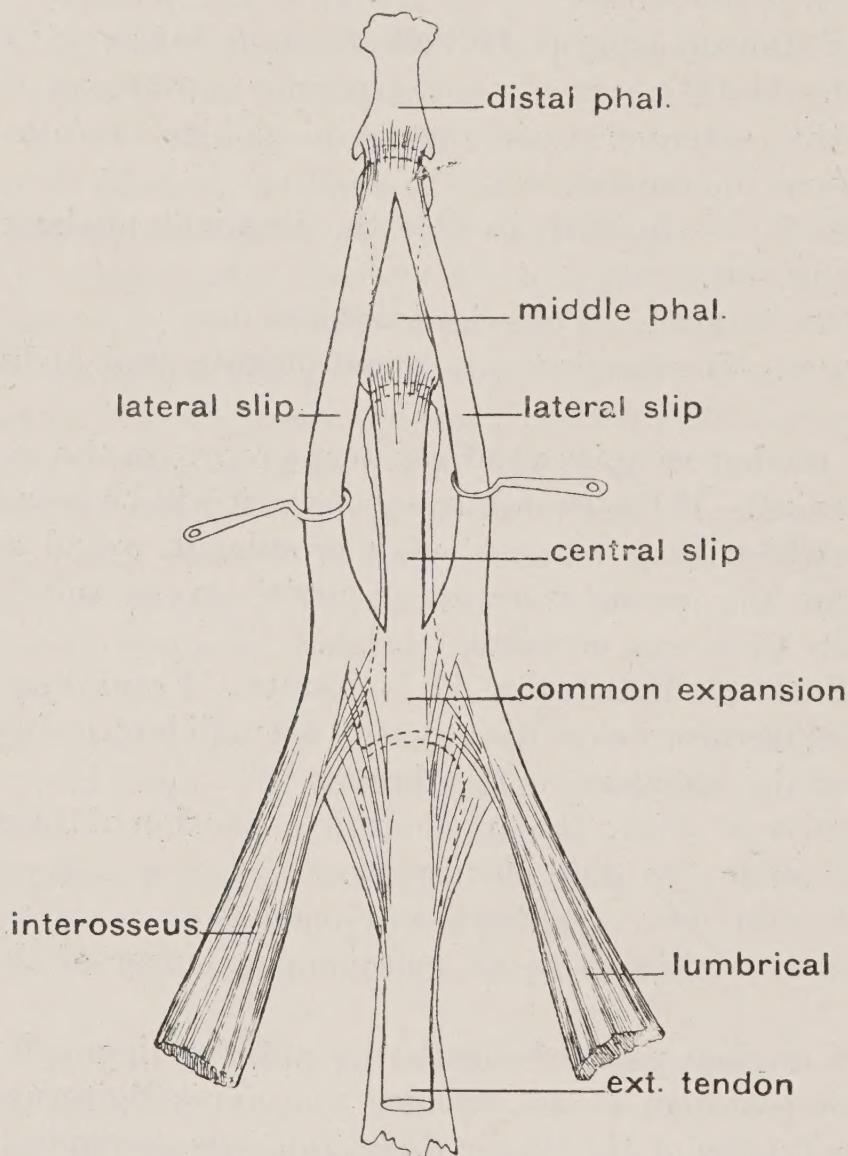
The tendon passes beneath the annular ligament in the same compartment as the extensor communis digitorum.

The *Tendon of the Flexor Carpi Radialis* should be followed to its insertion on the bases of the second and third metacarpal bones. The attachment of the anterior annular ligament to the groove on the trapezium must be removed.

The Interossei (fig. 49).—Seven small muscles fill the four interosseous spaces between the metacarpal bones. These muscles move the fingers laterally; three of them, the palmar interossei, are adductors; four of them, the dorsal interossei, are

abductors. In speaking of abduction or adduction of the fingers, the middle digit is regarded as the centre of movement. The deep transverse metacarpal ligament, uniting the heads of the metacarpal bones, has to be divided to examine the muscles.

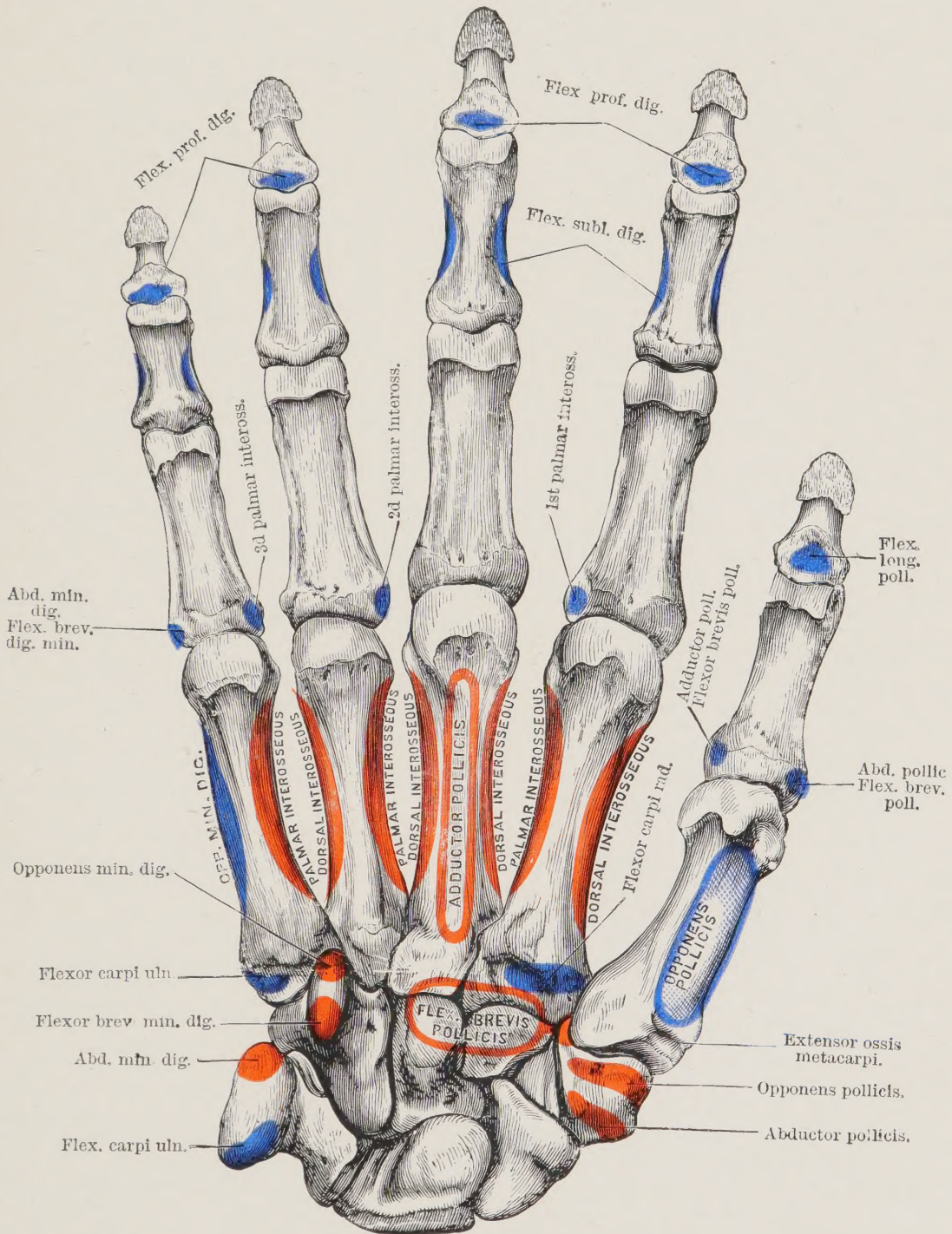
FIG. 48.—DIAGRAM TO SHOW THE TERMINATION OF EXTENSOR TENDONS ON A DIGIT. THE INTEROSSEUS MUSCLE ON THE RIGHT SIDE IS CUT AWAY TO EXPOSE THE LUMBRICAL MUSCLE. (*H. Balean.*)



The *Palmar Interossei* (fig. 49, A).—These three muscles adduct the index, ring and little fingers, towards the middle digit. Each arises from the base and palmar aspect of the metacarpal bone of its own digit (Plate XV). They are inserted to (1) the base of the proximal phalanx; (2) to the expansion of the extensor tendon (fig. 48) over the proximal phalanx.

PLATE XV.

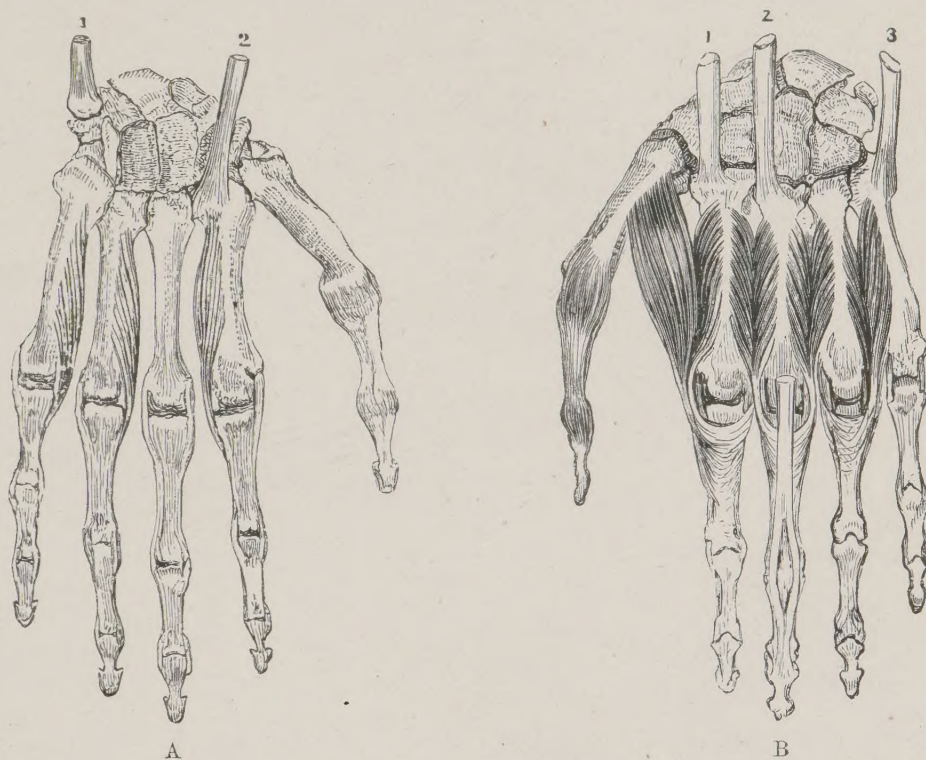
THE ORIGINS AND INSERTIONS OF MUSCLES TO THE PALMAR ASPECT OF THE HAND. (*After Holden.*)



They are inserted on the mesial side of the digit on which they act.

The *Dorsal Interossei* (fig. 49, B).—They are seen on the dorsal as well as on the palmar aspect of the hand. Two of them act on the middle digit; a third abducts the index, the fourth the ring finger. Each arises from the adjacent surfaces of the bases and shafts of two metacarpal bones. The first dorsal interosseous (abductor indicis) arises by two heads, one from the metacarpal bone of the thumb, the other from the metacarpal of the index finger; the radial artery enters the

FIG. 49.—THE DORSAL (A) AND PALMAR (B) INTEROSSEUS MUSCLES. (Heath.)



1. Tendon of flexor carpi ulnaris.
of flexor carpi radialis.

2. Tendon

1. Tendon of extensor carpi radialis longior.
2. Tendon of extensor carpi radialis brevior.
3. Tendon of extensor carpi ulnaris.

palm between its two heads. Each muscle is inserted to (1) the base of the proximal phalanx, and (2) the expansion of the extensor tendon on the proximal phalanx. It will thus be seen that each finger is provided with two interosseous muscles by which it can execute lateral movements and through which the fingers can be delicately adjusted.

NERVE SUPPLY.—From the deep branch of the ulnar nerve.

The student should again examine the order of the tendons as seen beneath the posterior annular ligament, studying them

carefully with the aid of the macerated bones and an osteological book (Plate XII).

Radial Artery at the Wrist (Plate XIII).—This artery has been already traced in the forearm and in the palm of the hand, where it forms the deep palmar arch. The intermediate portion, viz. that which lies in the region of the wrist and back of the hand, should now be examined.

COURSE.—At the lower end of the forearm it was seen to the outer side of the flexor carpi radialis lying on the pronator quadratus and anterior terminal border of the radius. It then winds outwards and backwards below the styloid process of the radius to reach the dorsum of the carpus, and disappears through the upper end of the first interosseous space, between the two heads of the first dorsal interosseous muscle, or abductor indicis.

RELATIONSHIPS.—In this part of its course it is covered by the skin, fascia, and some superficial nerves and veins. It is crossed by the extensor ossis metacarpi pollicis, extensor primi and extensor secundi internodii pollicis. It lies successively on the external lateral ligament, scaphoid and trapezium. Venæ comites accompany it, as is the case with all the arteries of the upper extremity.

BRANCHES.—(1) Posterior carpal.

(2) First dorsal interosseous.

(3) Two arteries to the dorsal of the thumb (Dorsales pollicis).

(4) Dorsalis indicis.

(1) The *posterior carpal*, a small branch, passes across the back of the carpus to join the posterior carpal branch of the ulnar artery, thus forming the posterior carpal arch. From this arch are given off the *second and third dorsal interosseous arteries* (Plate XIII). They pass along the third and fourth interosseous spaces and terminate on the dorsal surfaces of the fingers over the proximal phalanges. In the interosseous spaces these branches communicate by *perforating arteries* with (1) the deep palmar arch (posterior perforating) and near the web of the fingers with (2) the digital branches of the superficial palmar arch (anterior perforating).

(2) The *first dorsal interosseous artery* (metacarpal artery) is distributed on the second interosseous space in a manner similar to the others. It may be given off from the posterior carpal arch.

(3) The two *dorsales pollicis* pass to the dorsal surface of the thumb.

(4) The *dorsalis indicis* passes along the radial side of the index finger on its dorsal aspect.

After reaching the palm, and before joining to form the deep palmar arch, the radial artery gives off two branches already seen, viz. the princeps pollicis and radialis indicis.

Revision.—Before dissecting the ligaments connected with the articulations of the extremity, the student should carefully revise the various structures in the upper arm, forearm and hand, using at the same time, for reference and comparison, any other dissected parts or preparations in the dissecting-room or museum.

DISSECTION XI

THE LIGAMENTS AND JOINTS OF THE FOREARM AND HAND

Dissection of the Elbow-joint.—The triceps and brachialis anticus must be carefully reflected downwards from the shaft of the humerus so as to expose the loose membrane which forms the anterior and posterior parts of the capsular ligament. Part of the tendon of the biceps should be left *in situ*, so that the action of this muscle as a supinator may be studied. The interosseous membrane is to be exposed by completely removing the forearm muscles.

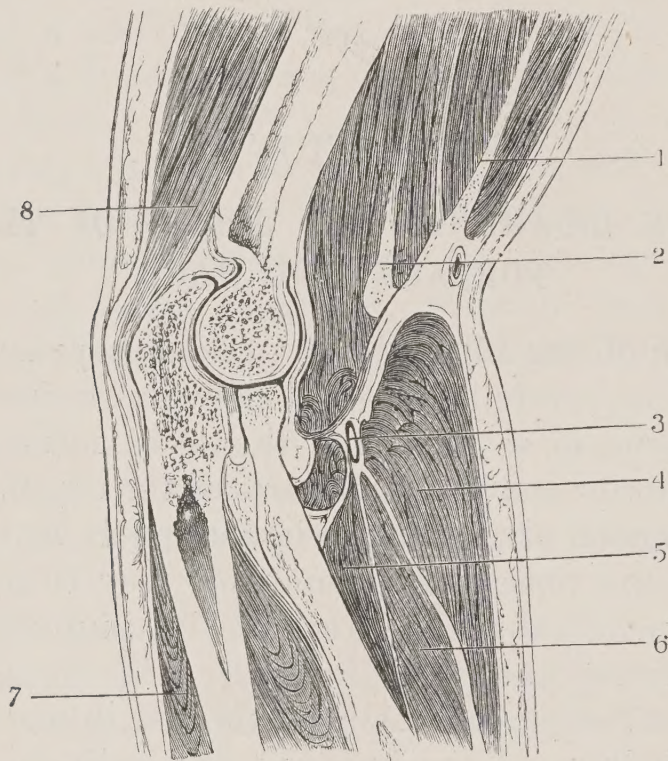
The elbow is a hinge-joint or ginglymus, in which the trochlea and capitellum of the humerus fit closely to the greater sigmoid cavity of the ulna and cup on the head of the radius (fig. 50). The bones are united together by a capsular ligament, which is specially thickened at each side of the joint to form the lateral ligaments.

(1) The *anterior ligament* (fig. 50) is thin, and attached above to the humerus immediately above the coronoid and the radial fossæ. Below it is attached to a groove on the margin of the coronoid process of the ulna and to the anterior part of the orbicular ligament. If fluid collects in the joint, it can scarcely be felt beneath the anterior ligament, owing to the biceps and brachialis anticus covering the capsule anteriorly (fig. 50).

(2) The *posterior ligament* is very thin, and is attached to the humerus immediately above the olecranon fossa, while below, it is attached to a narrow groove on the olecranon process near the articular margin (fig. 50). Fluid in the elbow-joint distends this part of the capsule. The swelling is felt at each side of the olecranon. The insertion of the triceps strengthens the joint behind.

(3) The *internal lateral ligament* is triangular in shape, being attached above by its apex to the internal condyle of the humerus. Inferiorly it divides into two bundles, the anterior of

FIG. 50.—SECTION OF THE ELBOW-JOINT. (*Braune.*)



1. Biceps. 2. Brachialis anticus. 3. Musculo-spiral nerve. 4. Supinator longus. 5. Supinator brevis. 6. Extensor carpi radialis longior. 7. Extensor carpi ulnaris. 8. Triceps.

which is attached to the inner margin of the coronoid process ; the posterior bundle is attached to the inner margin of the olecranon process. Transverse fibres pass across between these two bundles. The internal ligament is of very considerable thickness and strength.

(4) The *external lateral ligament* is attached above to the external condyle of the humerus, and below to the orbicular ligament. It is rope-like in form and extremely strong. The lateral ligaments are the chief bonds of the elbow-joint. The

strong extensor and flexor muscles protect the joint behind and in front.

The *synovial membrane* lines the inner surfaces of the ligaments and is prolonged into the fossæ at the lower end of the humerus (coronoid, radial and olecranon). Inferiorly it is continued into the superior radio-ulnar joint (fig. 50).

Movements.—**FLEXION.** Produced by the brachialis anticus, biceps, pronator radii teres, supinator longus and flexor muscles from the internal condyle.

EXTENSION.—By the triceps, anconeus, and extensor muscles from the external condyle.

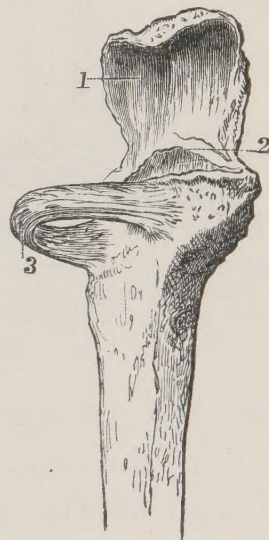
Radio-ulnar Articulations.—The radius and ulna articulate at their upper and lower extremities, forming (1) the superior and (2) the inferior radio-ulnar articulations. Their shafts are joined together by the interosseous membrane.

(1) **Superior Radio-ulnar Joint.**—Here the margin of the head of the radius articulates with the lesser sigmoid cavity of the ulna, the two bones being kept in apposition by the orbicular ligament.

The *orbicular* (fig. 51) or *annular ligament* is a strong band which forms about three fourths of a circle, and is attached to the anterior and posterior margins of the lesser sigmoid cavity of the ulna. It thus almost encircles the head of the radius; superiorly it is firmly attached to the anterior and external ligaments of the elbow, while below it is attached by a loose membranous layer to the neck of the radius (fig. 50). This attachment is so loose as to allow the head of the radius to rotate freely in the orbicular ligament. The supinator brevis, biceps, and oblique ligament (fig. 53) prevent the head of the radius being dislocated from the orbicular ligament, when the body is suspended from the hands. The hand is attached mainly to the radius, only partially to the ulna.

The *synovial membrane* is continuous with that of the elbow-

FIG. 51.—THE ORBICULAR LIGAMENT. (Wilson.)



1. Olecranon. 2. Tip of coronoid process. 3. Orbicular ligament.

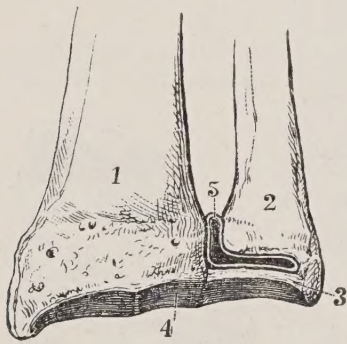
joint, and lines the inner surface of the orbicular ligament (fig. 50).

(2) **Inferior Radio-ulnar Joint.**—In this joint the head of the ulna articulates with the sigmoid cavity of the radius (fig. 52).

Ligaments.—The *anterior* and *posterior* ligaments are thin, and extend from the anterior and posterior margins of the sigmoid cavity of the radius to the anterior and posterior surfaces of the ulna, being joined above so as to form a capsule round the joint.

The *triangular fibro-cartilage* (fig. 52) is exposed when the anterior and posterior ligaments are cut away. It will be better seen when the wrist-joint is dissected. It is attached by

FIG. 52.—THE INFERIOR RADIO-ULNAR JOINT. (Wilson.)



1. Radius. 2. Ulna. 3. Interarticular fibro-cartilage. 4. Articular end of radius. 5. Membrana sacciformis.

its apex to a small pit near the root of the styloid process of the ulna, its base being attached to the ridge which separates the sigmoid cavity of the radius from its inferior articular surface. This fibro-cartilage separates the ulna from the carpal bones and wrist-joint (fig. 55).

The *synovial membrane* is very lax, hence it is called *membrana sacciformis*. It consists of a vertical part which extends upwards between the radius and ulna, and a horizontal part which lies between the ulna and the triangular fibro-cartilage (fig. 52). In a vertical section, the synovial cavity is L-shaped.

The **shafts of the radius and ulna** are united by the interosseous membrane and oblique ligament.

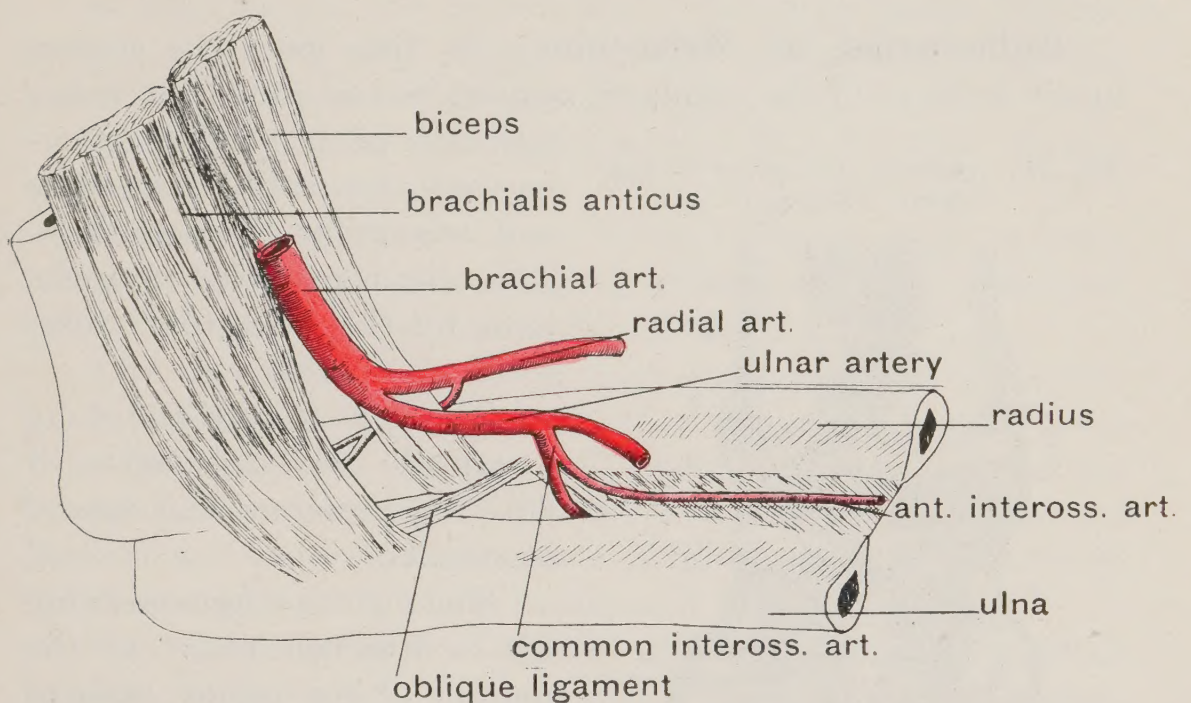
The *oblique ligament* (fig. 53) is a band of fibres stretching downwards and outwards from the lower part of the coronoid process of the ulna to the radius, just below the bicipital tuberosity. This ligament is frequently thin. It prevents dislocation of the head of the radius from the orbicular ligament.

The *interosseous membrane* is a strong fibrous sheet which is attached to the interosseous borders of the radius and ulna, extending from the inferior radio-ulnar joint almost as far as the bicipital tuberosity of the radius. Its fibres pass mainly

downwards and inwards from radius to ulna. On the posterior surface of the membrane, near its lower end, may be seen some fibres passing in the opposite direction, viz. downwards and outwards; these form an *inferior oblique ligament*. The interosseous membrane affords extensive attachment to muscles on its anterior and posterior surfaces.

Above its upper border there is a hiatus through which the posterior interosseous artery passes to the back of the forearm (fig 53), and, above the wrist, an inferior hiatus through

FIG. 53.—SHOWING THE ATTACHMENTS OF THE OBLIQUE LIGAMENT AND THE SUPERIOR RADIO-ULNAR HIATUS, THROUGH WHICH THE POSTERIOR INTEROSSEOUS ARTERY PASSES. (H. Bailean.)



which the anterior interosseous artery pierces the membrane in its lower third (fig. 54).

Movements.—The movements at the radio-ulnar joints are those of pronation and supination. In these movements, which the student should now study, the radius in part revolves round the ulna, so that while *in supination* the two bones are parallel, the radius lying on the outer side of the ulna throughout its entire length, *in pronation* the shaft of the radius crosses the ulna obliquely—the lower end of the radius (carrying with it the hand) coming to lie on a plane internal to the ulna—while the upper end of the radius still remains external to the ulna. The bones are most widely apart mid-

way between extreme pronation and supination, and it is in this position that the forearm is put up in cases of fracture of the radius and ulna. Supination is limited by the margin of the sigmoid cavity of the radius coming in contact with the tendon of the extensor carpi ulnaris (Morris). In complete pronation, the shaft of the radius and ulna come in contact.

SUPINATION.—Produced by the biceps, supinator brevis, and supinator longus.

PRONATION.—Pronator radii teres, pronator quadratus, flexor carpi radialis.

Radio-carpal or Wrist-joint.—In this joint the convex upper surfaces of the scaphoid, semilunar, and cuneiform bones

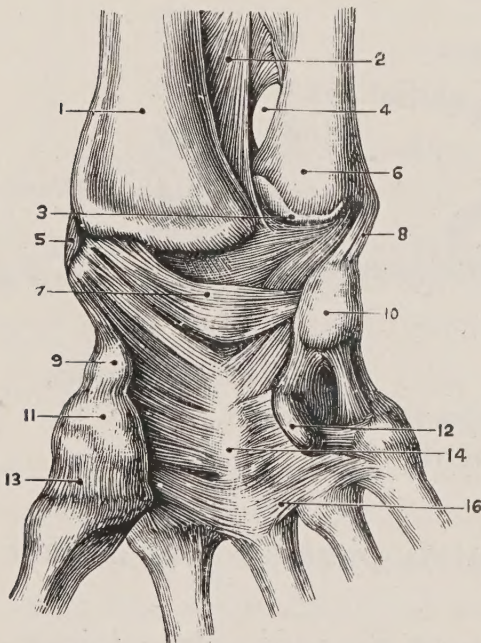
articulate in the shallow articular cavity formed by the radius and triangular fibro-cartilage. The ulna is excluded from the joint by the triangular fibro-cartilage (fig. 55).

The joint is surrounded by a capsule which consists of anterior, posterior, and lateral ligaments.

The *anterior ligament* (fig. 54) is attached above to the margin of the radius, close to the inferior articular surface, and extends to the anterior surfaces of the scaphoid, semilunar, and cuneiform bones.

The *posterior ligament* extends from the posterior margin of the inferior articular surface of the radius to the dorsal surfaces of the scaphoid, semilunar, and cuneiform bones.

FIG. 54.—ANTERIOR LIGAMENTS OF THE WRIST. (*Sappey.*)



1. Radius. 2. Interosseous membrane. 3. Articulation between lower end of ulna and triangular fibro-cartilage opened. 4. Space for anterior interosseous artery. 5. External lateral ligament of wrist. 6. Lower end of ulna. 7. Anterior ligament of wrist. 8. Internal lateral ligament of wrist. 9. Tubercle of scaphoid. 10. Pisiform bone. 11. Trapezium. 12. Hook of unciform. 13. Articulation between trapezium and first metacarpal. 14. Anterior ligament of carpus. 16. Ligaments uniting metacarpals with one another and with carpus.

The *internal lateral ligament* is somewhat fan-shaped, being attached by its pointed extremity to the styloid process

of the ulna. Below it spreads out to be attached to the cuneiform and pisiform bones and anterior annular ligament.

The *external lateral ligament* extends from the styloid process of the radius to the outer surface of the scaphoid ridge of the trapezium, and palmar aspect of the carpal bones (fig. 54).

The *synovial membrane* lines the capsule and occasionally communicates with the inferior radio-ulnar joint through an aperture in the triangular fibro-cartilage (fig. 55).

Movements.—PALMAR FLEXION.—Produced by the flexor carpi radialis, flexor carpi ulnaris, palmaris longus, and flexors of fingers and thumb.

DORSI-FLEXION OR EXTENSION.—Extensor carpi radialis longior, extensor carpi radialis brevior, extensor carpi ulnaris, extensors of fingers and thumb.

ULNAR FLEXION OR ADDUCTION.—Flexor carpi ulnaris, extensor carpi ulnaris.

RADIAL FLEXION OR ABDUCTION.—Flexor carpi radialis, extensor carpi radialis longior, extensor ossis metacarpi pollicis, extensor primi internodii pollicis.

The ulna should now be divided an inch above the wrist-joint. When the terminal part of the ulna is turned away from the radius the student will obtain a good view of the triangular fibro-cartilage. The wrist ligaments should be cut through and the articular surfaces of the carpal bones examined for their relationship to the radius and fibro-cartilage.

The Ligaments of the Carpus.—The carpal bones are bound together by three sets of ligaments: dorsal, palmar, and interosseous. A free movement takes place between the first and second rows of carpal bones in flexion and extension of the wrist.

The *dorsal carpal ligaments* are arranged in oblique, transverse and vertical bands, which unite the carpal bones on the dorsal aspect. They unite the carpal to the bases of the metacarpal bones.

The *palmar carpal ligaments* form a thick fibrous coating on the palmar aspect of the carpal bones. The arrangement of fibres is matted and irregular.

The *interosseous ligaments* unite adjacent rough surfaces of the carpal bones (fig. 55).

The *pisiform* is bound to the anterior surface of the cunei-

form, with which it articulates. The tendon of the flexor carpi ulnaris is inserted to the pisiform, fibres being prolonged to the unciform process and base of the fifth metacarpal bone.

Synovial Membranes.—The intercarpal, intermetacarpal, and carpo-metacarpal joints allow gliding movements. Between the upper and lower row of carpal bones a hinge movement

is permitted. There are four synovial cavities (fig. 55) between the carpal and metacarpal bones.

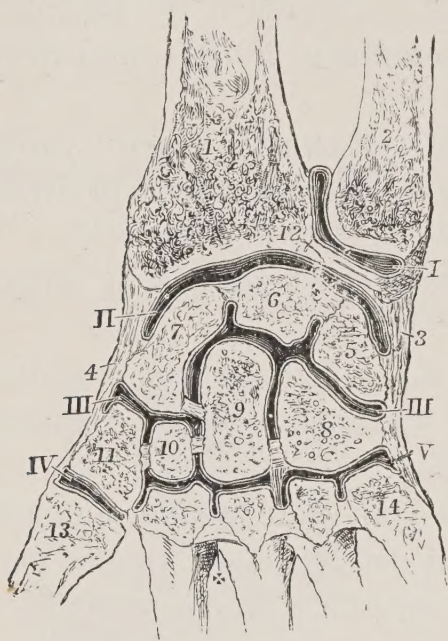
(1) Between the unciform and fourth and fifth metacarpal bones.

(2) Between the trapezium and first metacarpal.

(3) Between the pisiform and cuneiform.

(4) The other articular surfaces are lined by a common membrane.

FIG. 55.—A SECTION OF THE WRIST AND CARPUS, SHOWING THE SYNOVIAL MEMBRANES. (Wilson.)



- I. Sacciform membrane. II. Second synovial membrane. III. Third or large synovial membrane. IV. Synovial membrane between the trapezium and metacarpal bone of thumb. That of the pisiform bone is not visible in this view. V. Synovial membrane between unciform and two inner metacarpals. 1. Radius. 2. Ulna. 3. Internal lateral ligament. 4. External lateral ligament. 5. Cuneiform bone. 6. Semilunar. 7. Scaphoid. 8. Unciform. 9. Os magnum. 10. Trapezoid. 11. Trapezium. 12. Interarticular fibro-cartilage. 13. Metacarpal bone of thumb. 14. Metacarpal bone of little finger. X. Interosseous metacarpal ligaments. Interosseous ligaments are also seen connecting the bones of each row of the carpus.

Intermetacarpal Ligaments.—Interosseous ligaments connect the adjacent basal surfaces of the metacarpal bones. Dorsal, palmar, and interosseous fibres connect the bases with adjacent carpal bones. The heads of the metacarpal bones are joined together by the *transverse metacarpal* ligament, which is attached mainly to the palmar fibrous plates of the metacarpo-phalangeal joints.

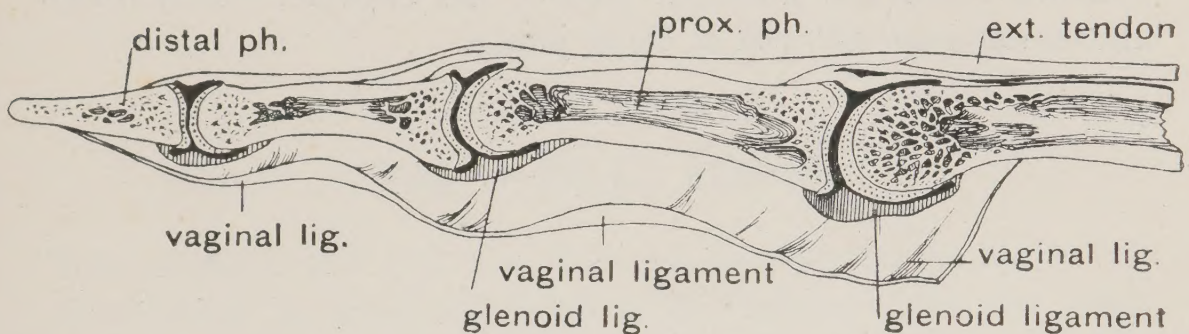
Metacarpo-phalangeal Articulations.—Dislocations are not uncommon at these articulations, especially between the metacarpal bone and proximal phalanx of the thumb. A study of these joints will show why a difficulty is frequently encountered in reducing a dislocation.

Three ligaments unite the head of a metacarpal bone with the base of the proximal phalanx, (1) the palmar or glenoid

and (2) two lateral ligaments. The dorsal expansion of the extensor tendons completes the capsule of the joint behind, filling the interval between the lateral ligaments (fig. 56).

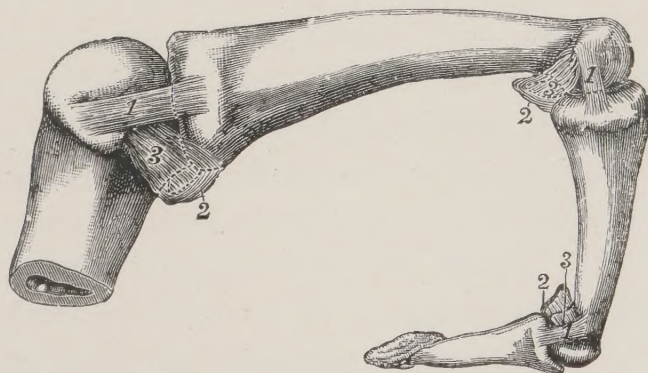
The *palmar or glenoid ligament* (fig. 56) is composed of a plate of dense fibrous tissue attached firmly to the anterior border of the basal phalanx. The head of the metacarpal bone

FIG. 56.—SECTION OF METACARPO-PHALANGEAL AND INTER-PHALANGEAL JOINTS, TO SHOW THE GLENOID LIGAMENTS. (H. Balean.)



rests on the plate. The plate lies as a shield between the joint and the deep flexor tendons. The fibro-cartilage is loosely attached behind the head of the metacarpal bone. Hence, in dislocation of the phalanx backwards, the fibrous plate is carried backwards with the phalanx and offers an obstacle to its reduction. Two sesamoid bones are imbedded in the glenoid

FIG. 57.—THE METACARPO-PHALANGEAL AND INTER-PHALANGEAL LIGAMENTS. (Wilson.)



1, 1, 1. Posterior part of lateral ligaments tense. 2, 2, 2. Anterior or glenoid ligaments.
3, 3, 3. Anterior part of lateral ligaments relaxed.

ligament over the head of the metacarpal bone of the thumb; these sometimes occur in the glenoid ligaments of the other digits.

The *lateral ligaments* unite the base of the phalanx and heads of the metacarpal bone (fig. 57). The fibrous plate

fills the interval between them on the palmar aspect of the joint.

Each joint is lined by a synovial membrane. The movements are principally flexion and extension, but lateral movements are also executed by the interosseus muscles.

Interphalangeal Joints.—The phalanges are strongly bound together by a stout *anterior* or palmar fibrous plate and *lateral* ligaments. The dorsal expansion of the extensor tendons forms the posterior part of the capsule. Only hinge movements are allowed at these joints.

DISSECTION OF THE LOWER EXTREMITY

DISSECTION I

THE GLUTEAL REGION

THE student will find the body on the dissecting table, face downwards, propped on blocks and placed so that the lower extremities hang freely over the end of the table. In this position the skin and muscles of the buttock or gluteal region are rendered tense and easy of dissection. This region he now proceeds to examine and dissect. It is absolutely necessary for the student to have a dried pelvis and femur by him for reference. He should place the pelvis in the same position as it occupies in the body before him.

Surface Markings.—The buttock or gluteal region cannot be sharply defined. It contains the muscles which pass from the outer and posterior aspect of the pelvis to the upper extremity of the femur (see figs. 60 and 61). The gluteal muscles cross the hip joint and extend the thigh. The student should note the following points in the gluteal region (fig. 58) :

1. The iliac crest, which separates the gluteal and abdominal regions. It ends behind in the *posterior superior iliac spine*, and in front at the anterior superior spine.

2. The *posterior inferior iliac spine*, a prominence behind and below the posterior superior spine. This spine marks the lower end of the ilio-sacral joint or synchondrosis.

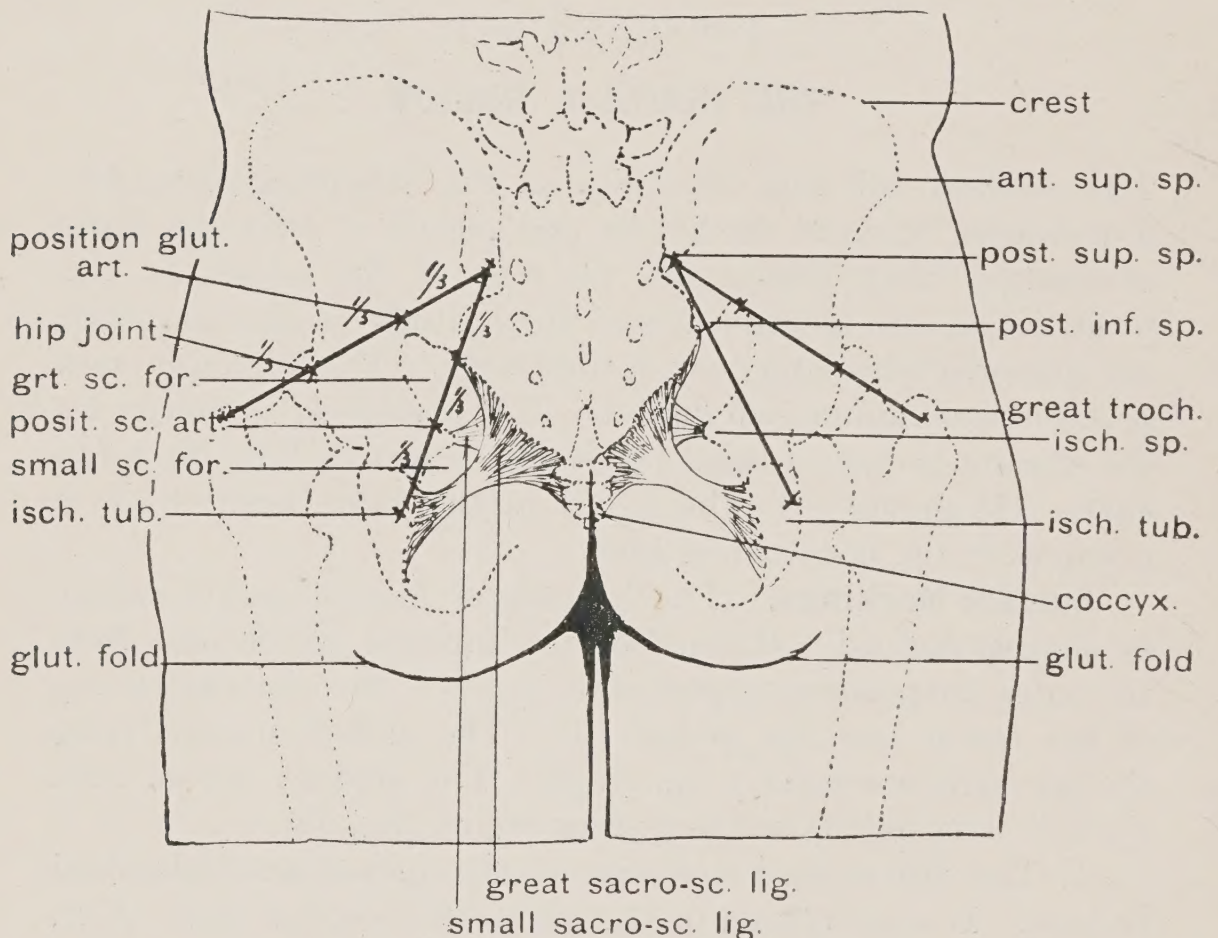
3. The *ischial tuberosity* can be felt at the distance of $1\frac{3}{4}$ inches from the side of the anus.

4. The *great trochanter* of the femur gives rise to the marked prominence on the outer aspect of the part, and marks the outer limit of the gluteal region. The tip of the trochanter touches a line drawn from the anterior superior spine to the

ischial tuberosity. In dislocation of the hip-joint the trochanter rises above or falls below this line.

5. The *gluteal fold* is not visible when the thigh is flexed or partially flexed. When it is extended, as when a man stands erect, a well-marked crescentic fold comes out, crossing below the ischial tuberosity and turning upwards over the lower border of the gluteus maximus as it passes outwards. It is produced in the same manner as the folds seen over the

FIG. 58.—SHOWING THE SURFACE MARKINGS OF THE GLUTEAL REGION.



knuckles when the fingers are extended. In hip-joint disease the fold disappears. The gluteal fold marks the lower boundary of the gluteal region.

6. The *position of the sacro-sciatic foramen* should be noted. Through it the great nerves and some minor vessels pass from the pelvis to the thigh and perineum (fig. 64). The *posterior inferior iliac spine* lies at the upper end of the foramen; the sacrum, which can be felt, bounds it posteriorly. The great sacro-sciatic ligament which helps to bound the foramen below

and behind is attached to the ischial tuberosity. The foramen, which is divided into a great and small division by the small sacro-sciatic ligament, thus lies between the posterior inferior iliac spine and the ischial tuberosity. The position of the great sacro-sciatic ligament should be closely noted because it is the boundary between the gluteal region and perineum, a part which belongs to the dissection of the abdomen. If the student dissects the lower extremity for the first time, he may obtain assistance from the dissectors of the abdomen, who are now at work on the posterior region of their part.

REFLECTION OF THE SKIN.—The skin is reflected by three incisions.

(1) One made from the first sacral spine, along the crest of the ilium to the anterior superior spine. This incision has probably been made already by the dissectors of the abdomen.

(2) A vertical incision made along the posterior middle line from the spine of the first sacral vertebra to the tip of the coccyx; then the incision deviates laterally so as to leave an ellipse of skin two inches wide round the anus. The incision terminates on the inner side of the thigh, three inches below the ischial tuberosity.

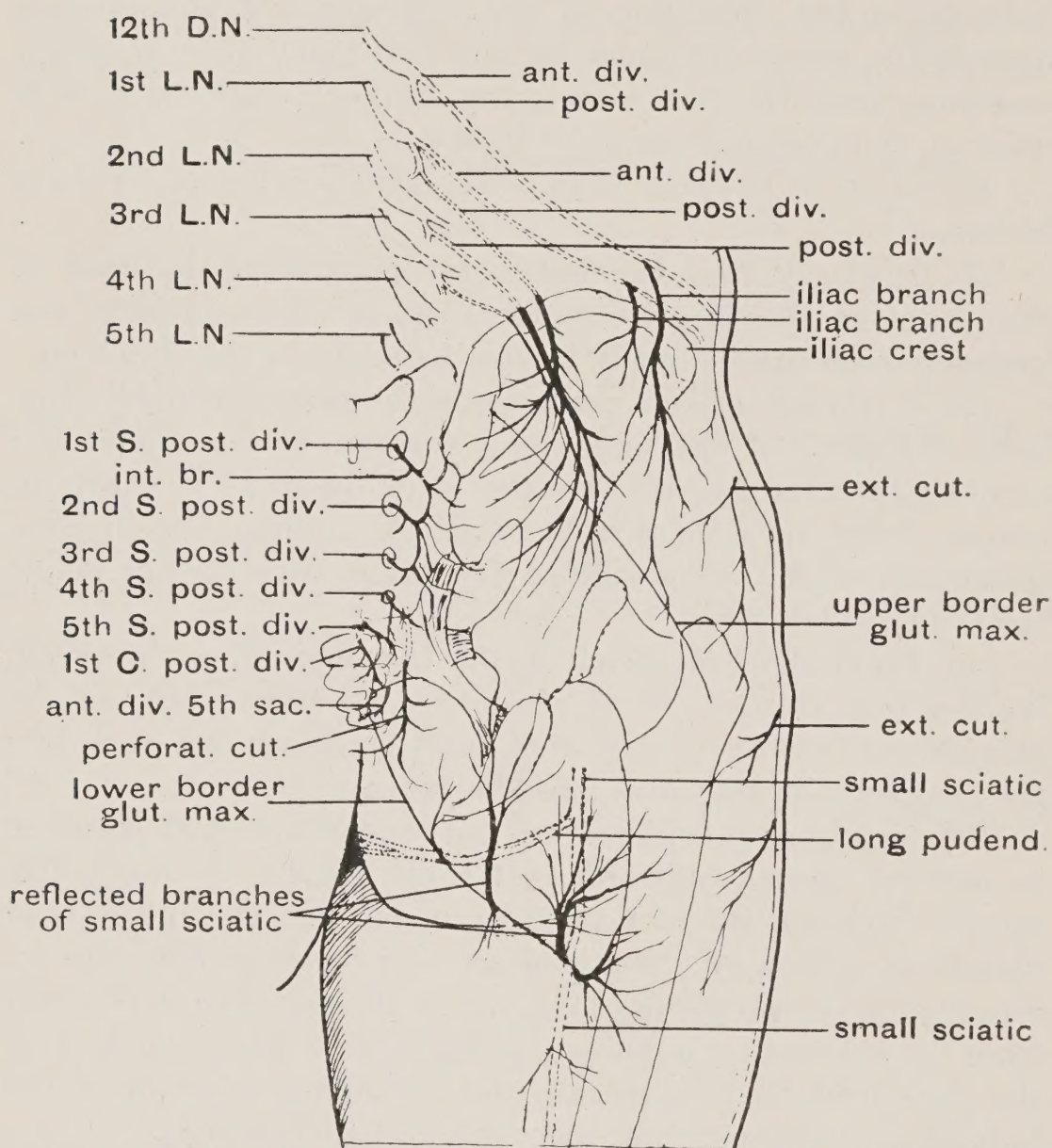
(3) From the lower end of the last incision a transverse incision is to be made outwards across the thigh; but, as the skin there is relatively thin, care must be taken not to injure the structures in the subcutaneous tissue.

The flap of skin thus marked out is to be raised at its inner border and turned outwards. It must not be cut away, but retained to cover the part and keep it moist in the intervals of dissection. As a rule the student will have no difficulty in recognising the proper depth at which the skin is to be reflected from the subcutaneous tissue (see fig. 2, p. 3) which binds it to the parts beneath, for generally the subcutaneous tissue of the buttock is loaded with fat, especially in female bodies.

The Superficial Fascia (Subcutaneous Tissue) and the Structures which are to be found in it.—The subcutaneous tissue is made up of loose bundles of fibrous tissue woven irregularly together. The areolæ or meshes between the bundles are generally filled with groups of cells loaded with fat. The superficial fascia binds the skin to the deep fascia (see fig. 2). The student is now to seek for the *nerves* (fig. 59) which ramify in the superficial fascia and end in the skin of the buttock. Five of

them cross the crest of the ilium from the loins ; the dissectors of the abdomen will assist in finding these. Each nerve must be carefully cleaned and followed towards its final ramifications in the skin.

FIG. 59.—SHOWING THE CUTANEOUS NERVES OF THE GLUTEAL REGION.



Cutaneous Nerves.—Entering this region *over the crest* of the ilium are (fig. 59) :

- (1) The *lateral cutaneous* branch of the last dorsal nerve.
- (2) The *iliac branch* of the ilio-hypogastric nerve.
- (3) The *posterior branches* of the three upper lumbar nerves (fig. 3).

The lateral branch of the last dorsal nerve crosses the crest

of the ilium about one inch and a half behind the anterior superior iliac spine. The iliac branch of the ilio-hypogastric nerve appears about an inch further back, and crosses the crest a short distance behind a tubercle on the outer margin of the crest.

The external branches of posterior divisions of the lumbar nerves cross the crest, close to the outer margin of the erector spinæ. These nerves pass downwards and outwards from the crest towards the great trochanter of the femur. To understand the origin and course of the nerves consult fig. 4, p. 6, and fig. 59.

Entering the region from the inner side are:—

(1) The *posterior divisions of the sacral nerves*, usually three in number, which pierce the gluteus maximus close to its origin (fig. 59). The external branches of these become cutaneous.

(2) A few twigs of the *perforating cutaneous nerve*, a branch from the fourth sacral nerve (figs. 59 and 66).

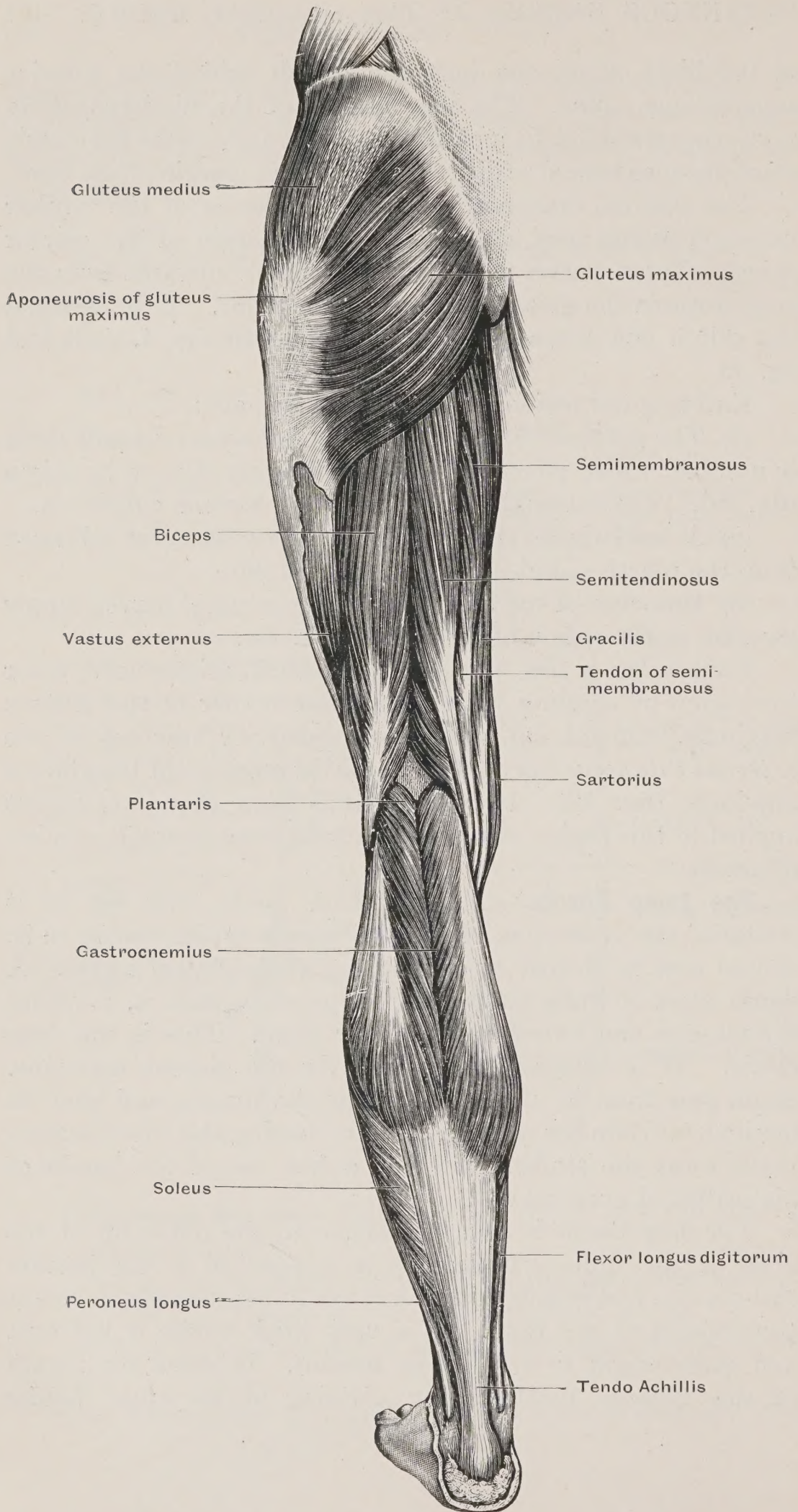
(3) Branches of the fifth sacral and coccygeal nerves supply the skin in the region of the coccyx (fig. 59).

From *below* a few branches of the small sciatic nerve enter the region by winding round the lower border of the gluteus maximus. On the *outer* side some posterior branches of the *external cutaneous nerve* ramify over the insertion of the gluteus maximus (fig. 59). It will be thus seen that punishment applied to this region of the body affects a considerable number of nerves.

The Deep Fascia.—The superficial fascia with the fat it contains, the cutaneous nerves and vessels which ramify in it, should now be cleared away from the whole gluteal region. A dense sheet of white tissue will be found beneath it, covering the muscles and forming sheaths for them. This is the deep fascia. It is comparatively thin over the gluteus maximus. Septa pass from its deep surface into the muscle and bind its fasciculi into bundles (see fig. 2). In clearing the subcutaneous tissue away the student will find a free use of the handle of his scalpel of great service.

The deep fascia is attached above to the outer lip of the crest of the ilium. Posteriorly it is attached to the sacrum and coccyx, and blends with the fascia lumborum which covers the muscles of the back. It is very thick where it lies over and gives origin to the gluteus medius. It forms the sheath of the gluteus maximus by dividing at its upper border

FIG. 60.—SUPERFICIAL MUSCLES OF THE BACK OF THE THIGH AND LEG.
(From Morris's 'Anatomy'.)



into a very thin layer which passes under the muscle and a thicker layer which covers its superficial surface. This superficial layer becomes especially thick and blends with the insertion of the muscle to the ilio-tibial band (fig. 60). Externally, over and in front of the great trochanter, the deep fascia is specially thickened to form the ilio-tibial band. By means of this band the greater part of the gluteus maximus is inserted to the deep fascia of the thigh and external tuberosity of the tibia.

Gluteus Maximus (fig. 60).—This muscle, which is one of the most powerful of the body, is now to be studied. With it, as with every other muscle of the limb, the student must proceed to display (1) the origin; (2) the insertion; (3) the borders.

The deep fascia which forms the superficial part of its sheath is then to be removed. This must be done by commencing at one border and running the knife along the muscle fibres from origin to insertion, gradually working towards the opposite border. The deep fascia is thus removed as a continuous sheet. The gluteus maximus is a very coarse muscle with large fasciculi.

ORIGIN.—From the dorsum ilii between the superior curved line and the iliac crest, from the sides of the sacrum below the posterior inferior spine and coccyx, from the fascia lumborum and from the surface of the great sacro-sciatic ligament (Plate XVI).¹

INSERTION.—The greater part of the muscle is inserted into the ilio-tibial band of the fascia lata, a portion only of the deep fibres of the muscle being inserted into the gluteal ridge on the femur (Plate XVII).

The deep aspect of the insertion of the muscle to the fascia and gluteal ridge requires much cleaning. A large bursa, a sac with smooth lubricated walls, will be found between the muscle and the great trochanter near the insertion. It allows the muscle to play over the trochanter without friction.

ACTION.—If the student will balance his body on one leg and place his hand over this muscle he will find it plays an active part in *abducting* the body so as to poise it over the thigh. If the

¹ In making out the origins and insertions of muscles, the student will derive great assistance by consulting the osteological plates in which the muscular attachments are indicated. These plates are arranged so that they may be conveniently consulted as the dissection is proceeded with.

limb is free it *abducts* the thigh on the body. If he stoops he will find that the muscle is a chief agent in raising the body. It extends the hip-joint. Further, it is an external rotator, rolling the thigh outwards at the hip-joint.

NERVE SUPPLY.—The inferior gluteal, from the sacral plexus. The nerve enters the muscle on its deep surface and will be seen when the muscle is reflected (fig. 66).

The **Parts beneath the Gluteus Maximus** are now to be examined (see figures 61, muscles; 62, vessels; 63, nerves).

The gluteus maximus should be detached neatly along its origin and turned down. The reflection requires care and a great deal of dissection. The dissector should follow the plane of fascia covering the gluteus medius. When completely reflected, the muscle is divided at its insertion and removed. This cannot be done until the points of insertion have been fully displayed.

While reflecting the muscle, notice:—(1) the branches of the gluteal artery, entering it opposite the upper part of the great sciatic notch; these must be divided (fig. 62). (2) The piriformis will next appear, and below it (3) the sciatic nerves and vessels. With them (4) the inferior gluteal nerves and branches of the sciatic vessels enter the deep surface of the muscle and must be divided. (5) The remaining external rotators will now appear passing outwards towards the upper end of the femur (fig. 61).

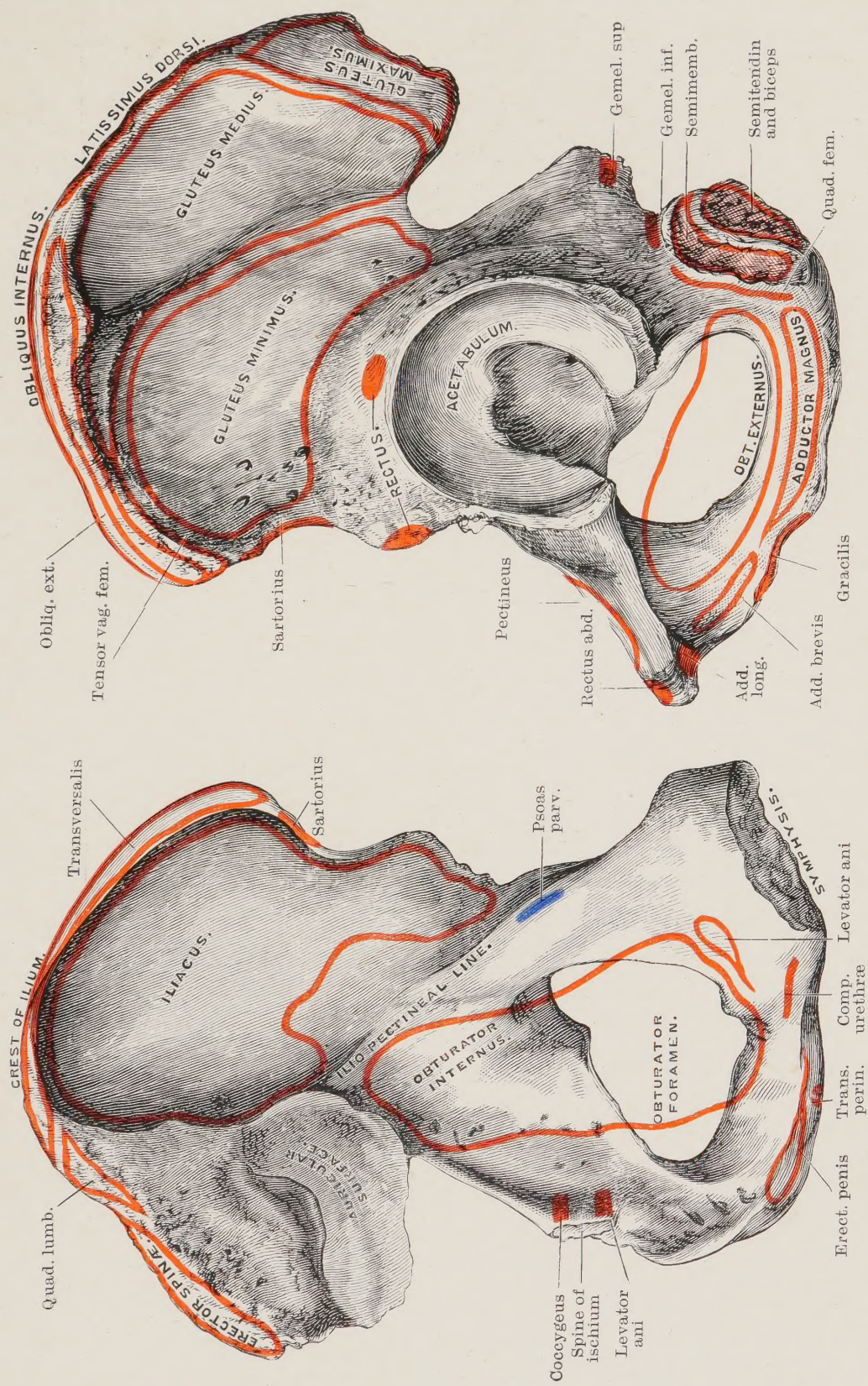
These structures, and others, beneath the muscle must now be cleaned and examined in detail.

(a) **BONY SURFACES.**—The bony surfaces from which the muscle arises will be exposed on reflecting the muscle. These are parts of the ilium, sacrum and coccyx, also the tuberosity of the ischium and great trochanter of the femur. The spine of the ischium and the lesser trochanter of the femur can also be felt, though they are not distinctly exposed.

(b) **BURSÆ.**—An inconstant and ill-defined bursa lies over the tuber ischii. The bursa separates the skin and permits it to glide on the tuberosity in the sitting posture. In the region of the great trochanter a multilocular bursa lies under the gluteus maximus and its tendon of insertion. The upper part of this lies over the great trochanter, and the lower part over the vastus externus. These two parts are sometimes distinct.

(c) **MUSCLES** (fig. 61).—(1) The gluteus medius is for the most part covered by the gluteus maximus. Below it is (2)

THE POINTS OF MUSCULAR ATTACHMENT ON THE OS INNOMINATUM. (*After Holden.*)



the piriformis, which emerges from the great sciatic foramen. Next in order will be found (3) the tendon of the obturator internus, and (4) the two gemelli on each side of it. Below these is (5) the quadratus femoris. Passing outwards transversely, close to the quadratus are some of the upper fibres of (6) the adductor magnus. Passing vertically downwards from the tuber ischii are (7) the hamstring muscles, and lastly just below and external to the great trochanter is (8) the vastus externus.

By lifting up the lower border of the gluteus medius, a part of the gluteus minimus is exposed, and the tendon of the obturator externus can be shown by separating the quadratus femoris from the gemellus inferior.

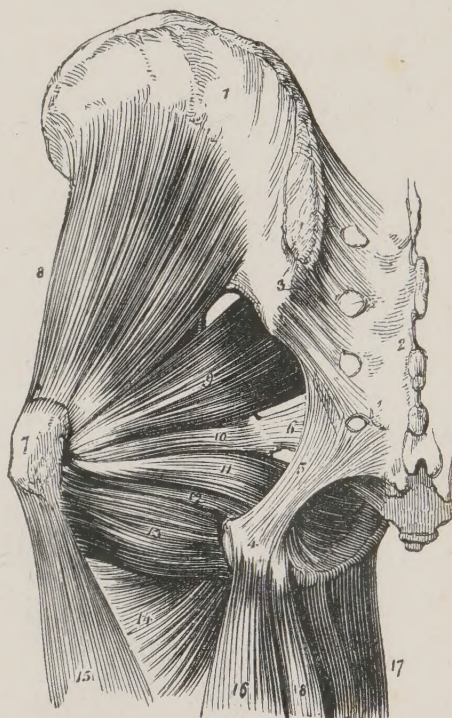
(d) LIGAMENTS (fig. 64).—

(1) The great sacro-sciatic ligament is seen in its entire length. Its borders should be defined. Underneath it (2) the lesser sacro-sciatic ligament can be felt; and by separating the gemellus inferior from the quadratus femoris, (3) the posterior part of the capsule of the hip-joint is exposed, with the obturator externus tendon on its surface.

(e) VESSELS AND NERVES (figs. 62 and 63).—Appearing between the gluteus medius and

piriformis are (1) the gluteal vessels and (2) superior gluteal nerve. Below the piriformis emerge (3) the greater and (4) lesser sciatic nerves, (5) the sciatic vessels, and (6) the inferior gluteal nerve. Crossing the spine of the ischium are (7) the pudic nerve and (8) pudic artery, with (9) the nerve to the obturator internus (fig. 64). Between the gemellus inferior and quadratus femoris are seen (10) the nerve to the

FIG. 61.—SHOWING THE MUSCLES BENEATH THE GLUTEUS MAXIMUS. (Wilson.)



1. Ilium. 2. Sacrum. 3. Posterior sacro-iliac ligament. 4. Tuberosity of the ischium. 5. Great sacro-sciatic ligament. 6. Lesser sacro-sciatic ligament. 7. Trochanter major. 8. Gluteus minimus. 9. Piriformis. 10. Gemellus superior. 11. Obturator internus, passing out of the lesser sacro-sciatic foramen. 12. Gemellus inferior. 13. Quadratus femoris. 14. Adductus magnus. 15. Vastus externus. 16. Biceps. 17. Gracilis. 18. Semi-tendinosus. The tendon of the obturator externus appears between the gemellus inferior and the quadratus femoris.

quadratus femoris and (11) the ascending branch of the internal circumflex artery. Between the quadratus femoris and the adductor magnus is (12) the transverse branch of the same artery.

The nerve to the quadratus femoris can always be found as it emerges from the sciatic foramen beneath the great sciatic nerve (fig. 66).

Gluteus medius.—ORIGIN. From the interval between the crest of the ilium and the middle curved line and from the strong fascia which covers it (Plate XVI).

INSERTION.—Into an oblique line on the outer surface of the great trochanter of the femur (Plate XVII). A small bursa lies between the tendon of insertion and the upper part of the great trochanter.

NERVE SUPPLY.—To find the *superior gluteal nerve*, the posterior border of the gluteus medius must be separated from the adjacent border of the piriformis. The gluteal artery will be found emerging from the sciatic foramen (fig. 63); lying beneath the artery, between it and the edge of the foramen, will be found the superior gluteal nerve. It divides into two branches, an upper and a lower, which can be followed when the gluteus medius is reflected.

ACTION.—Like the gluteus maximus, it helps to balance the body on the thigh. It abducts the lower extremity. Its anterior fibres rotate the thigh inwards; its posterior rotate it outwards.

The gluteus medius is now to be raised from its origin, dissected downwards to its insertion and completely removed. Its anterior border is hard to define, for it is covered by and partly confluent with the *Tensor Vaginæ* or *Fasciæ Femoris*. The dissector should find and clean the following structures which lie beneath the muscle:—(1) The Gluteal Artery; (2) The superior Gluteal Nerve; (3) The Gluteus minimus.

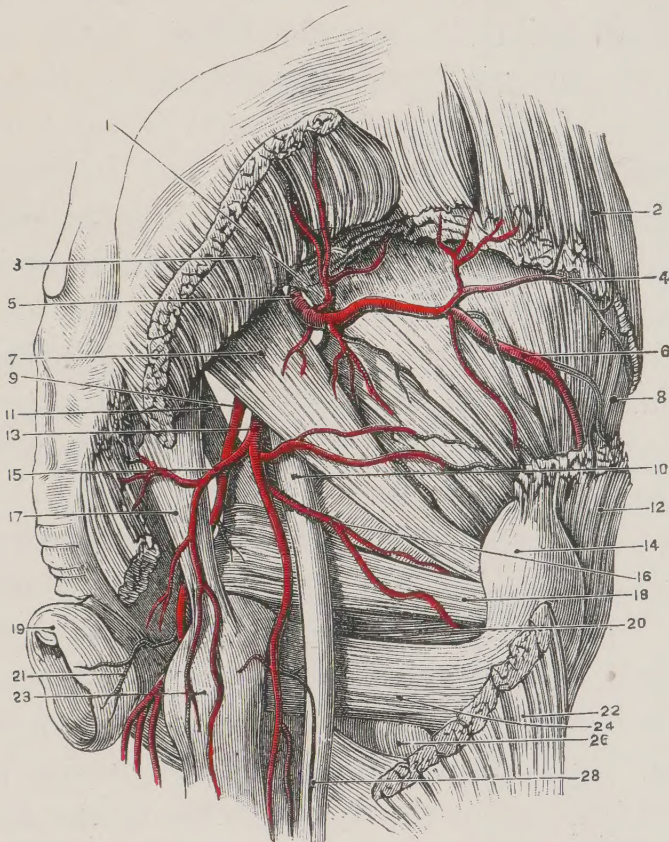
Gluteal Artery.—This is the continuation of the posterior division of the internal iliac artery (fig. 65), and leaves the pelvis through the upper part of the great sacro-sciatic foramen. It appears in the buttock above the piriformis, and divides immediately into a (1) superficial and (2) deep division.

The *Superficial Division* gives off numerous branches to the gluteus maximus.

The *Deep Division* (fig. 62) passes forwards beneath the

gluteus medius and divides into an (*a*) upper and (*b*) lower branch. The *upper branch* follows the origin of the gluteus medius from the middle curved line of the ilium and anastomoses under the tensor fasciæ femoris with the ascending branch of the external circumflex artery (fig. 83). The *inferior branch* passes downwards and outwards on the surface of the gluteus minimus towards the great trochanter of the femur.

FIG. 62.—SHOWING THE ARTERIES BENEATH THE GLUTEUS MAXIMUS. (Henle.)



1. Gluteal artery (superficial branch). 2. Gluteus medius (origin). 3. Gluteus maximus (origin). 4. Superior deep gluteal artery. 5. Trunk of gluteal artery. 6. Inferior deep gluteal artery. 7. Piriformis. 8. Gluteus minimus. 9. Pudic artery. 10. Great sciatic nerve. 11. Small sacro-sciatic ligament. 12. Gluteus medius (insertion). 13. Sciatic artery. 14. Great trochanter. 15. Coccygeal branch of sciatic artery. 16. Anastomotic branch of sciatic artery. 17. Great sacro-sciatic ligament. 18. Obturator internus and the two gemelli. 19. External sphincter ani. 20. Tendon of obturator externus. 21. Inferior hæmorrhoidal artery. 22. Insertion of gluteus maximus. 23. Ischial tuberosity. 24. Quadratus femoris. 26. Small trochanter. 28. Comes nervi ischiadici.

The **Superior Gluteal Nerve** arises from the lumbo-sacral cord and first sacral nerve (fig. 66). It leaves the pelvis with the gluteal artery and supplies branches to the gluteus medius, gluteus minimus, and tensor fasciæ femoris (fig. 63).

Gluteus Minimus.—**ORIGIN.** From the dorsum ilii between the middle and inferior curved lines (Plate XVI).

INSERTION.—Into an impression on the anterior surface of

the great trochanter of the femur (Plate XXIV). A small bursa lies close to its insertion between the bone and the tendon.

NERVE SUPPLY.—The superior gluteal nerve.

ACTION.—It is an abductor and inward rotator of the thigh.

On turning down the gluteus minimus the *reflected head* of the *rectus femoris* will be exposed (Plate XVI).

The *Arteries* and *Nerves* which issue *below the Piriformis* are now to be cleaned and followed as far as they lie in the gluteal region. The structures now to be sought for are :

1. The Sciatic Artery (fig. 62, 13).
2. The Small Sciatic Nerve (fig. 63, 8).
3. The Great Sciatic Nerve (fig. 63, 16).
4. The Pudic Artery (fig. 62, 9).
5. The Pudic Nerve (fig. 63, 7).
6. The Nerve to the Obturator Internus (fig. 63, 5).

Sciatic Artery.—This artery is a branch of the anterior division of the internal iliac artery (fig. 65) and leaves the pelvis through the lower part of the great sciatic foramen below the piriformis. It passes down with the sciatic nerves towards the upper part of the thigh, where it terminates in small muscular and cutaneous branches.

BRANCHES.—It sends a branch along the great sciatic nerve, the *comes nervi ischiadici*. As it emerges it gives off a *coccygeal branch* which perforates the great sacro-sciatic ligament and ends in the tissues by the side of the coccyx. *Muscular* branches are given off to the gluteus maximus and other muscles of the gluteal region. The *digital* branch ends in the peri-articular plexus of the hip-joint in the digital fossa of the femur.

The **small sciatic nerve** (fig. 63, 8), a branch of the sacral plexus, appears in the gluteal region below the piriformis, on the outer surface of the great sciatic nerve, and directly underneath the gluteus maximus. The inferior gluteal nerve to the gluteus maximus is frequently united with it. It passes over the hamstring muscles, under the deep fascia, and courses down the back of the thigh to reach the popliteal space and upper part of the calf, terminating in the skin of these parts. Its course down the back of the limb will be followed afterwards. It is the cutaneous nerve of the back of the thigh, knee, and calf (Plate XVIII). In the *gluteal region* it supplies :

(a) Branches which wind round the lower border of the gluteus maximus to supply the skin on its surface (fig. 59).

(b) The *long pudendal nerve* (fig. 63), which winds inwards over the origin of the hamstring muscles, $1\frac{1}{2}$ inches below the tuber ischii, to reach the skin of the perineum and scrotum.

Great Sciatic Nerve.—The great sciatic—the main continuation of the sacral plexus (fig. 66)—is the largest nerve in the body. It appears in the gluteal region, through the lower part of the great sciatic foramen, below the pyriformis. It passes downwards midway between the tuber ischii and great trochanter of the femur. At this point, as it emerges from the cover of the gluteus maximus and before it disappears beneath the hamstrings, the surgeon exposes and stretches the great sciatic nerve in cases of intractable sciatica (fig. 63). The student should therefore pay particular attention to the relationships of the nerve at this point. A line drawn from a point midway between the tuber ischii and great trochanter to the mid-point on the posterior aspect of the knee-joint marks the course of the nerve in the thigh.

It terminates about the middle of the thigh by dividing into the internal and external popliteal nerves.

FIG. 63.—SHOWING NERVES BENEATH THE GLUTEUS MAXIMUS. (Hirschfeld and Leveillé.)

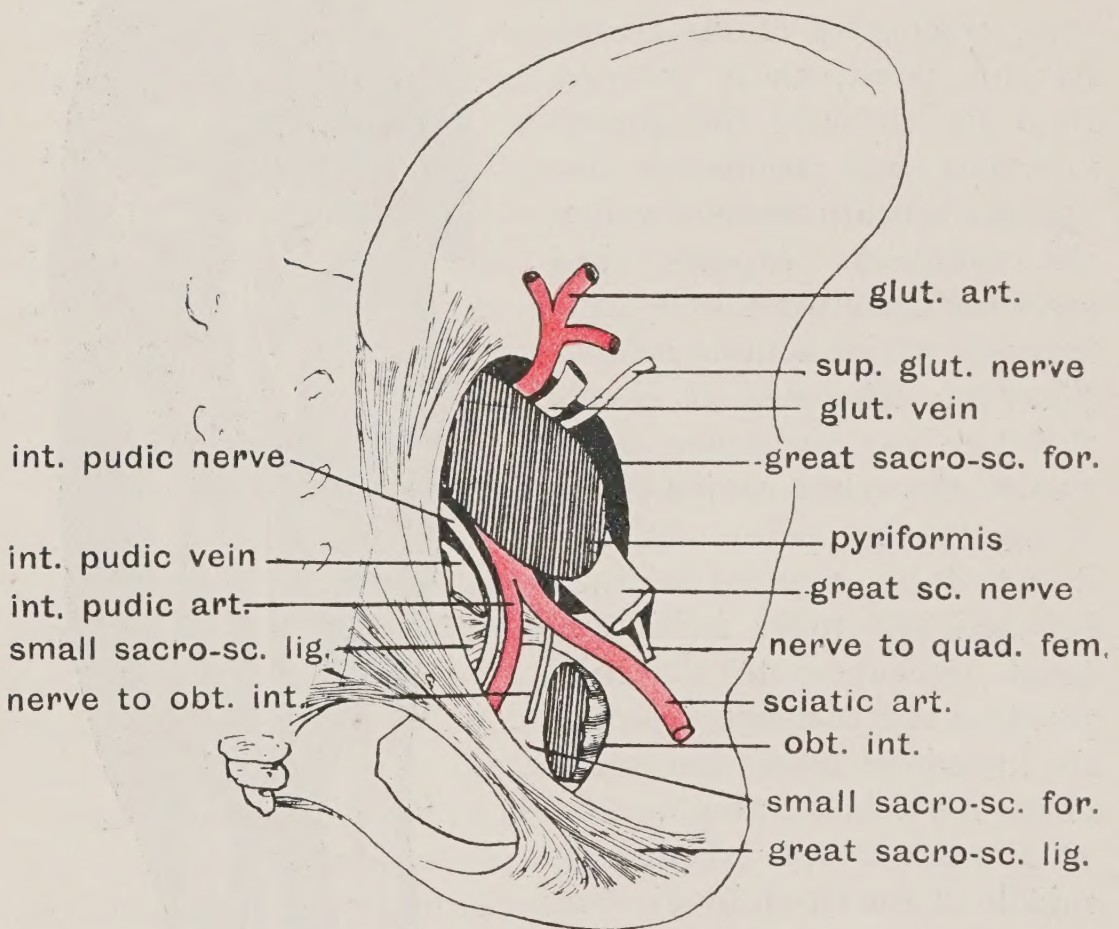


1. Gluteus maximus. 2. Gluteus medius. 3. Gluteal artery and nerve. 4. Gluteus minimus. 5. Nerve to obturator internus. 6. Pyriformis. 7. Pudic nerve. 8. Small sciatic nerve. 9. Great sacro-sciatic ligament. 10. Obturator internus and gemelli. 11. Inferior gluteal nerve. 12. Tendon of obturator externus. 13. Inferior pudendal nerve. 14. Quadratus femoris. 15. Gracilis. 16. Great sciatic nerve. 17. Adductor magnus. 18. Insertion of gluteus maximus. 19. United origins of semi-tendinosus and biceps. 20. Short head of biceps. 21. Semi-membranosus. 22. Tendon of biceps. 23. Tendon of semi-tendinosus. 24. External popliteal nerve. 25. Internal popliteal nerve. 26. Communicans peronei nerve. 27. Popliteal artery. 29. Gastrocnemius. 31. Communicans tibialis nerve.

It is covered *superficially* by the gluteus maximus and hamstring muscles, and in the gluteal region the small sciatic nerve and sciatic vessels lie upon it. From above downwards it *lies upon* the bone, the obturator internus and two gemelli, the quadratus femoris and adductor magnus (fig. 61).

Occasionally the great sciatic nerve separates into its two terminal divisions within the pelvis. In such cases the upper division (external popliteal nerve) pierces the piriformis.

FIG. 64.—SHOWING THE STRUCTURES WHICH FORM AND THOSE WHICH PASS THROUGH THE SACRO-SCIATIC FORAMINA. (H. Balean.)



BRANCHES.—In its course down the back of the thigh, it supplies at an early stage branches to the hamstring muscles and to the inner part of the adductor magnus.

External Rotator Muscles.—(1) **Piriformis**—**ORIGIN.** The origin of this muscle is seen in the dissection of the pelvis. The muscle is now examined as it emerges at the sciatic foramen. It arises from the anterior surfaces of the 2nd, 3rd, and 4th pieces of the sacrum within the pelvis and from the upper margin of the sacro-sciatic foramen.

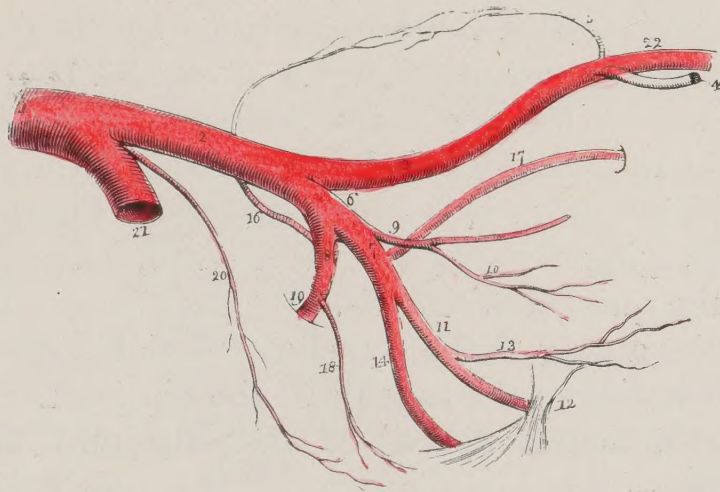
INSERTION.—Into the summit of the great trochanter by a narrow tendon (Plate XXIV).

NERVE SUPPLY.—A branch enters the deep surface of the muscle from the great sciatic nerve.

(2) The **Obturator Internus** is seen as it emerges from the small sciatic foramen, between the small and great sacro-sciatic ligaments (fig. 64). The two **Gemelli** form intrinsic parts of the muscle.

ORIGIN (see Plate XVI).—It arises from the inner surface of the obturator membrane and the inner surface of the ischium

FIG. 65.—SHOWING THE ORIGIN OF THE GLUTEAL, SCIATIC, AND INTERNAL PUDIC ARTERIES FROM THE INTERNAL ILIAC WITHIN THE PELVIS. (Wilson.)



1. Aorta. 2. Left common iliac artery. 3. External iliac. 4. Deep epigastric artery. 5. Deep circumflex iliac. 6. Internal iliac artery. 7. Its anterior trunk. 8. Its posterior trunk.
9. The pervious portion of the umbilical artery giving off (10) the superior vesical artery.
11. Internal pudic artery passing behind the spine of the ischium (12) and lesser sacro-sciatic ligament. 13. Middle hæmorrhoidal artery. 14. Sciatic artery, also passing behind the lesser sacro-sciatic ligament to escape from the pelvis. 16. Ilio-lumbar ascending to inosculate with the circumflex iliac artery (5) and form an arch along the crest of the ilium. 17. Obturator artery. 18. Lateral sacral. 19. Gluteal artery passing through the upper part of the great sacro-sciatic foramen. 20. Sacra media. 21. Right common iliac artery cut short. 22. Femoral artery.

as high as the great sciatic notch. Its tendon turns sharply round a cartilaginous groove between the ischial spine and tuberosity. Here it is joined by the *superior gemellus* from the spine of the ischium and the *inferior gemellus* from the outer margin of the tuber ischii. These muscles hide the obturator tendon. The conjoined tendon, formed by the three muscles, dips under the tendon of the pyriformis to be *inserted* into the anterior part of the inner surface of the great trochanter close to its upper border (Plate XVII).

TENDON OF THE OBTURATOR INTERNUS.—Cut through the gemelli and obturator tendon in front of the lesser sciatic

foramen. When the emerging obturator is lifted from the groove it occupies, its deep surface is seen to contain a leash of tendons which ply over the smooth cartilaginous surface of the groove. A bursa lubricates the passage of the tendon, which should be followed outwards to its insertion and cut away.

NERVE SUPPLY.—The nerve to the obturator internus will be found crossing the ischial spine outside the pudic artery (fig. 63, 5). It comes from the sciatic plexus (fig. 66). The superior gemellus is supplied by the nerve to the obturator internus; the inferior gemellus receives a twig from the nerve to the quadratus femoris.

(3) **Quadratus Femoris.**—**ORIGIN.** From the outer margin of the tuber ischii (Plate XVI).

INSERTION.—Into a tubercle and ridge on the posterior part of the great trochanter of the femur (Plate XVII).

The *nerve* to the quadratus femoris will be found as it emerges from the sacro-sciatic foramen beneath the great sciatic nerve. It passes down beneath the obturator internus and two gemelli, and, lying close to the tuber ischii, it enters the deep surface of the quadratus femoris.

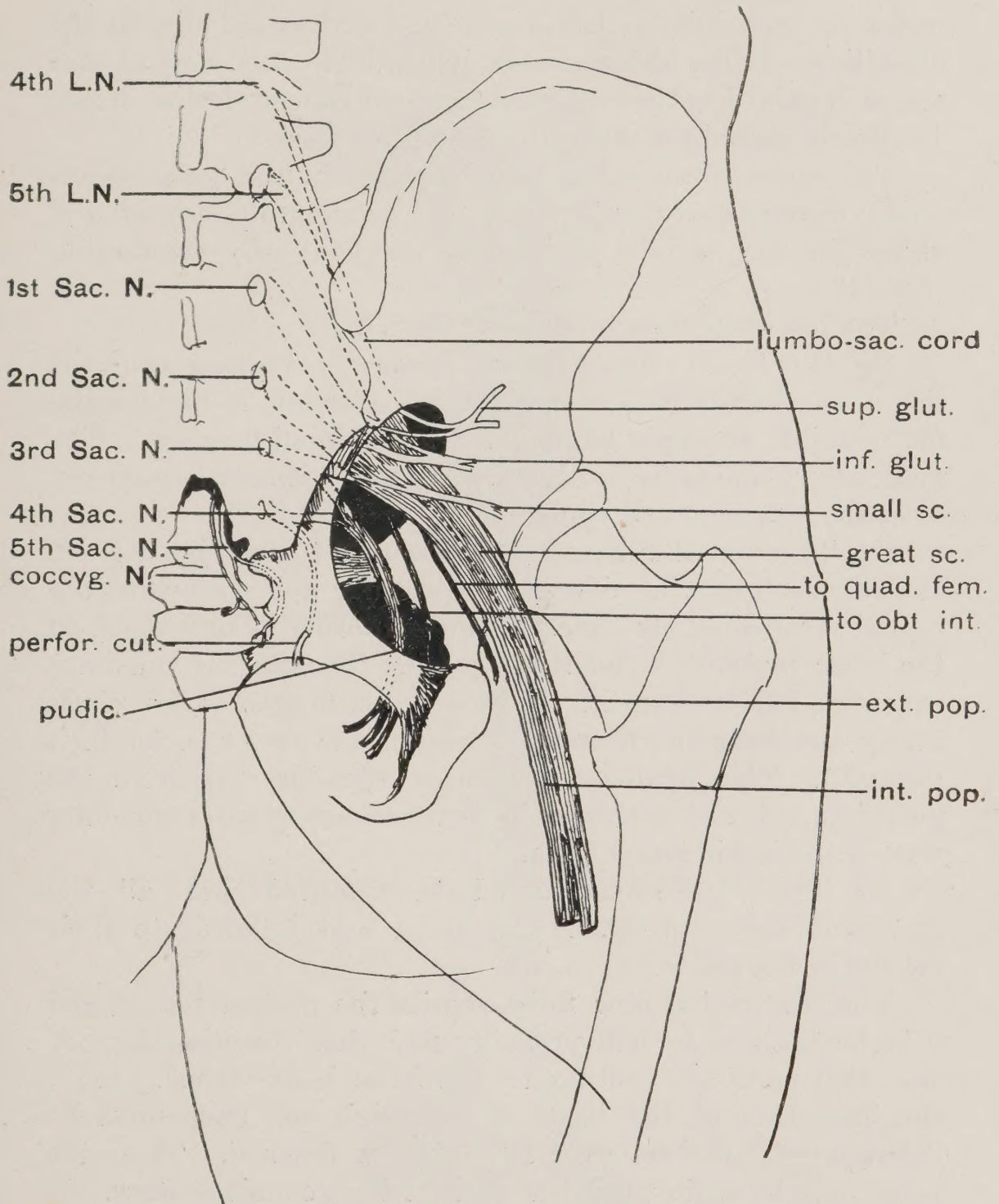
It supplies a twig to the gemellus inferior and an *articular* branch which pierces the capsule of the hip-joint.

The Peri-articular Plexus of the Hip-joint and Crucial Anastomosis.—The hip-joint, as is the case with all the joints of the extremities, is surrounded by a chain-work of arteries, derived from many sources (see figs. 62 and 67). Part of this anastomotic network is now to be seen on the posterior aspect of the joint. The gluteal artery joins the periarticular plexus.

The *crucial anastomosis* is part of the plexus and is formed by branches from four arteries, viz. (1) the sciatic; (2) the internal circumflex (fig. 67); (3) the external circumflex; and (4) the first perforating artery (fig. 67). The *Sciatic Artery* has already been traced downwards from the sciatic foramen until it breaks up into branches behind the hip-joint. The *first perforating artery*, a branch of the deep femoral, appears at the lower border of the quadratus femoris. At the upper border of this muscle appears the *internal circumflex*; the transverse branch of the *external circumflex* turns round the femur below the insertion of the gluteus maximus and anastomoses with the internal circumflex. These four arteries

unite freely together in the region behind the hip-joint, and form roughly the outline of a cross. Both circumflex arteries are branches of the deep femoral (fig. 83).

FIG. 66.—DIAGRAM TO SHOW THE FORMATION AND CHIEF BRANCHES OF THE SACRAL PLEXUS. (A. K.)



The *Tendon of the Obturator Externus* will be found resting on the capsule of the joint when the quadratus femoris is

cut through. It is inserted in the digital fossa between the great trochanter and neck of the femur. The origin will be seen in the dissection of the front of the thigh.

The Sciatic (Sacro-sciatic) Foramen (fig. 64).—The boundaries of this foramen are now to be defined, and the structures which escape by it re-examined. For the greater part the deep region on each side of the sacrum and coccyx belongs to the dissectors of the abdomen; it is through this region that access is gained to the rectum in cases of cancer of that organ. They will assist in making the structures clear

The sciatic foramen is bounded *below* by the great sacro-sciatic ligament, *in front* by the os innominatum, *behind and above*—in the upright position of the body—by the sacrum (fig. 64).

The following structures are to be noted :

(1) The *Small Sacro-sciatic Ligament*.—Passing from the side of the sacrum to the spine of the ischium, it divides the foramen into an upper large and a lower small foramen. The pudic artery and nerve, with the nerve to the obturator internus, cross the ligament and spine.

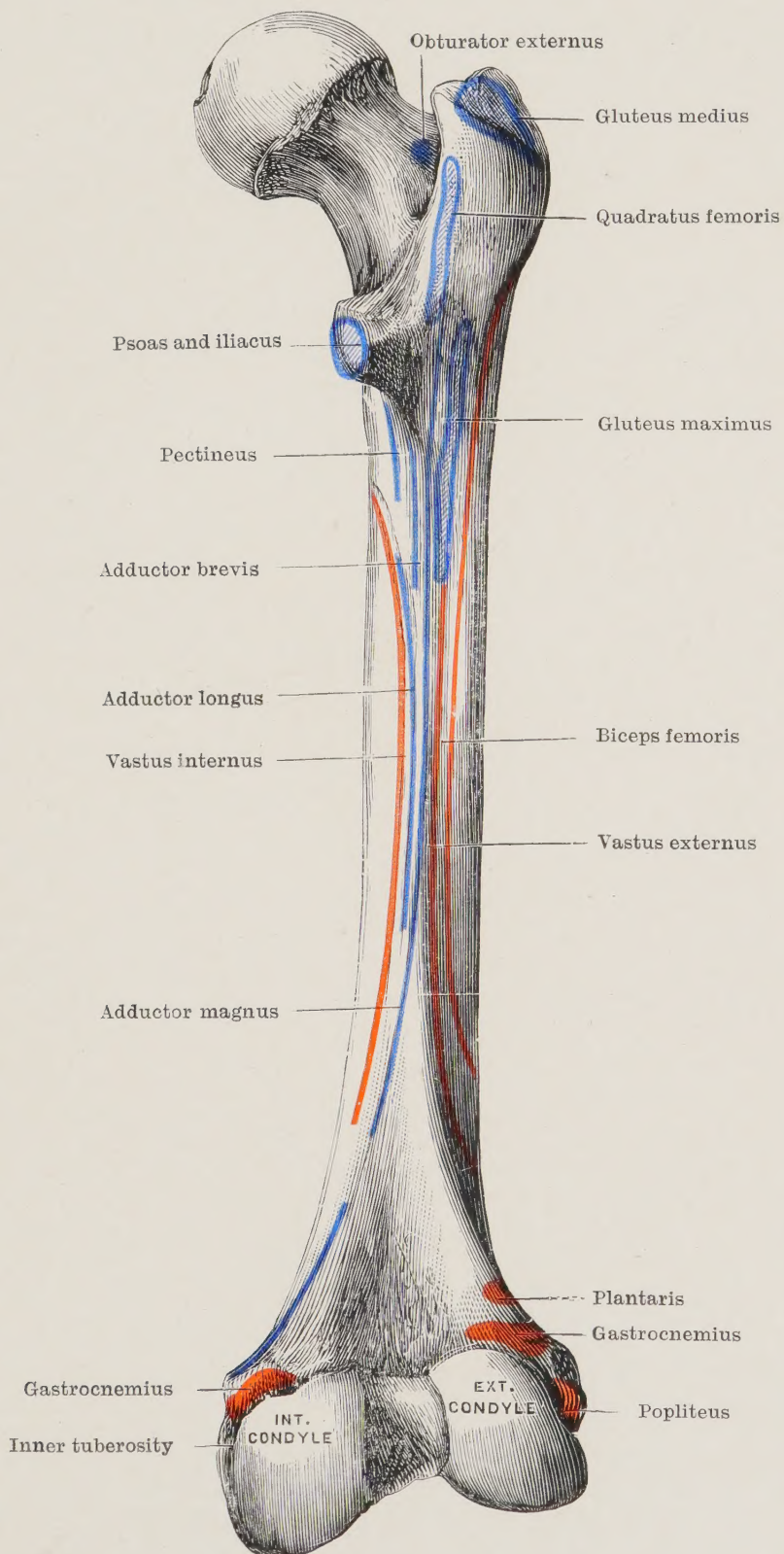
(2) The *Great Sacro-sciatic Ligament* must be defined. It stretches from the side of the sacrum and coccyx to the ischial tuberosity; its inner falciform border is prolonged on the inner margin of the tuber ischii. The gluteus maximus covers and arises from it. The coccygeal branch of the sciatic artery and branches from the lowest sacral nerves perforate it (fig. 66). The ligament separates the buttock from the perineum. Under it the pudic nerve and artery enter the outer wall of the ischio-rectal fossa.

(3) The *Pyriformis* should be removed and all the structures shown in fig. 64 examined and followed to their origins in the pelvis.

The student has now finished with the gluteal region, and if he has dallied he will probably find that the dissectors of the other parts are waiting to have the body turned. If so, the dissection of the back of the thigh and knee must be deferred until the front of the thigh is finished. Then the body may be again turned on its face for a couple of days. It is more convenient, however, if the student can complete the dissection at the back of the thigh now.

PLATE XVII.

THE POINTS OF MUSCULAR ATTACHMENT ON THE FLEXOR
ASPECT OF THE FEMUR. (*After Holden.*)



DISSECTION II

BACK OF THE THIGH AND POPLITEAL SPACE

No advantage is gained by dissecting these regions separately as commonly described. By the concurrent dissection of the two regions the student is enabled to trace down the hamstring muscles and the popliteal nerves uninterruptedly. The identification of structures in the popliteal region is simplified, the articular branches of the popliteal nerves are less likely to be removed, and much valuable time is saved.

Surface Markings.—(1) The *Tuber Ischii*. The tuber ischii was exposed by the reflection of the gluteus maximus. The student will observe it now as a rounded bony prominence from which the great hamstring muscles arise. It bounds the perineal space laterally; the *ascending* ramus of the ischium can be felt passing forwards from it, at the junction of the thigh and perineum.

(2) The student will find that a deep fossa or recess comes out behind the knee when it is flexed. The prominent lateral boundaries of the space contain the tendons of the hamstring muscles (fig. 60). When the knee is extended, all trace of a fossa disappears, and an eminence takes its place. The space behind the knee is the *Popliteal Space*. Its boundaries will be more fully explained when it comes to be dissected. In it lie the popliteal artery, vein, and nerves.

The body should be drawn well on to the table, and the limbs raised to a convenient height. It is important to keep the hamstring muscles tense. The knee should be kept extended.

REFLECTION OF THE SKIN.—Having made an incision across the calf, about 4 or 5 inches below the bend of the knee, and a vertical incision along the back of the thigh, the skin over this extensive region should be reflected outwards and inwards. The flaps are retained to cover the part and keep it moist.

Superficial Nerves and Vessels.—In the subcutaneous tissue, the dissector should find:

(1) Branches of the *small sciatic nerve* appearing at intervals through the deep fascia.

(2) Terminal branches piercing the deep fascia over the lower part of the popliteal space.

(3) The *short saphenous vein* piercing the deep fascia to enter the popliteal space (fig. 68, 17). A part of the vein frequently passes upwards to join deep veins beneath the hamstring muscles.

(4) Small cutaneous twigs of the *sciatic artery* are found over the upper part of the thigh.

(5) Close to the lower part of the popliteal space, a cutaneous branch of the popliteal artery accompanies the small sciatic nerve and short saphenous vein.

The deep fascia is to be reflected by the same incisions as were used to reflect the skin. Beneath it, rather to the inner side of the middle line of the thigh, will be found the *small sciatic nerve*. It should be traced to its termination in the upper part of the calf and cut away.

Deep Fascia.—In the thigh the deep fascia forms a fibrous tubular sheath for the thigh, enclosing the muscles and other structures, and binding all together. The superficial fascia is removed to expose it. Above it is continuous with the gluteal fascia, and below, where it extends over the popliteal space, it is specially thickened by transverse or oblique fibres.

On each side of the hamstrings the fascia sends inwards intermuscular septa (fig. 84) to be attached to the outer and inner lips of the linea aspera. The *outer intermuscular septum* is the stronger of the two, and lies between the short head of the biceps and the vastus externus muscles. It extends from the gluteal ridge to the external condyle of the femur. The *internal septum*, thin and not well marked, lies between the hamstring and adductor muscles (fig. 84).

Hamstring Muscles.—The three hamstring muscles—biceps, semitendinosus, and semimembranosus—extend from the tuber ischii to the tibia and fibula on the back of the thigh, forming a rounded prominent mass. They separate below to enclose the popliteal space, the biceps passing to the outer side and the semitendinosus and semimembranosus to the inner side of the space (fig. 60).

Biceps Flexor Cruris.—ORIGIN by two heads: (1) The *long head* arises by a tendon, common to it and the semitendinosus, from the lower and inner part of the back of the tuber ischii (Plate XVI).

(2) The *short head* arises from the outer lip of the linea aspera and the external intermuscular septum.

INSERTION.—After passing along the outer wall of the popliteal space, it is inserted by a rounded tendon into the outer surface of the head of the fibula, the deep surface of its tendon being partially divided by the external lateral ligament of the knee-joint (Plate XX). Fascial slips extend from the tendon to the outer tuberosity of the tibia and to the fascia of the leg.

NERVE SUPPLY.—The great sciatic nerve supplies a branch to the long head in the upper part of the thigh; the short head receives a branch lower down from the external popliteal division of the nerve.

ACTION.—It flexes the knee-joint and extends the hip-joint. If the leg and foot are fixed as in stooping, the long head, like the other hamstring muscles, help to raise the body to the upright position. It uses the ischium as a lever to raise the body.

Semitendinosus.—ORIGIN. By fleshy fibres from the tendon of the biceps and ischial tuberosity.

INSERTION.—By a long rounded tendon into the inner surface of the tibia, distal (beyond) to the insertion of the gracilis, and beneath the insertion of the sartorius (Plate XXI). An oblique tendinous septum crosses the muscle about its middle. The tendon forms the prominent inner margin of the popliteal space.

NERVE SUPPLY.—From the great sciatic nerve.

ACTION.—It extends the thigh and flexes the leg, and also rotates the leg slightly inwards.

Semimembranosus.—ORIGIN. By a long and razor-blade tendon from the back of the tuber ischii above the external to the biceps and semitendinosus (Plate XVI). The tendon lies beneath the biceps and semitendinosus.

INSERTION.—Mainly by a rounded tendon into (1) a groove on the internal tuberosity of the tibia beneath the internal lateral ligament; (2) by a tendinous expansion which joins the posterior ligament of the knee-joint (fig. 101); (3) by another expansion which joins the aponeurotic expansion over the popliteus muscle. The insertion of the tendon will be better seen when the knee-joint is examined.

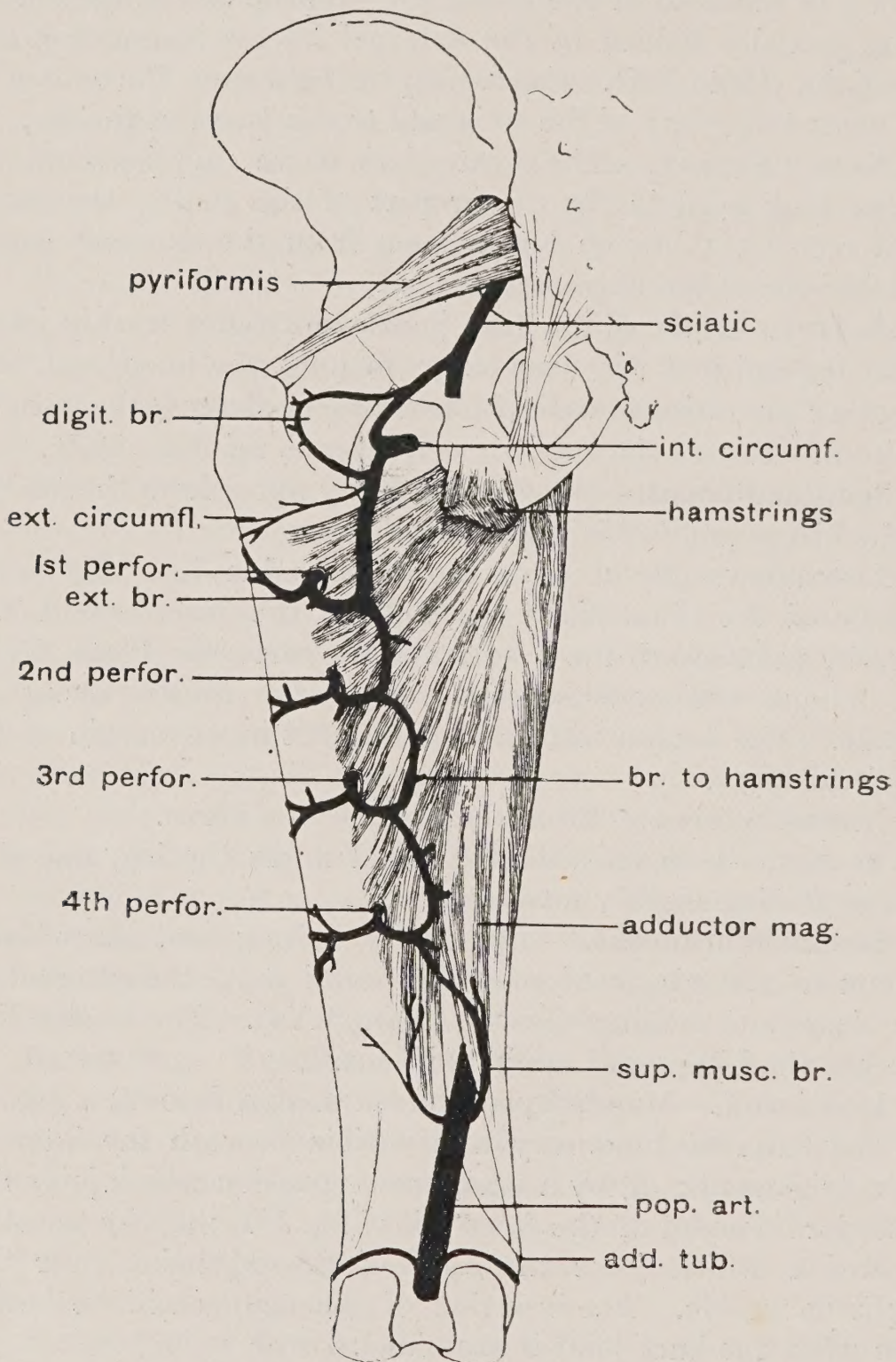
NERVE SUPPLY.—From the great sciatic.

ACTION.—Similar to the semitendinosus.

The Blood Supply of the Hamstring Muscles.—As the

student cleaned the hamstring muscles, he must have observed numerous arteries entering their deep surface. The

67.—THE POSTERIOR ASPECT OF THE ADDUCTOR MAGNUS, WITH THE TERMINAL PARTS OF THE PERFORATING ARTERIES. (*Ridge and Baleqn.*)



muscles rest on the posterior aspect of the *adductor magnus muscle*. This muscle should be cleaned and defined on

its posterior surface. Three or perhaps four arteries will be found to appear at its insertion to the femur. These are the *perforating branches* of the deep femoral artery (fig. 67). Each artery sends a branch to the vastus externus on the outer aspect of the thigh, and another to the hamstring muscles. The hamstring branches form an anastomotic arterial chain from the gluteal artery above to branches of the popliteal artery below.

DISSECTION III

THE POPLITEAL SPACE

The popliteal space lies behind the knee-joint; when the knee is flexed it is filled by the origin of the calf muscles; complete flexion would be impossible were this space absent. In disease of the knee-joint pus may find its way into the space and fill it; numerous bursæ, which may become enlarged, lie in it and near it; the popliteal artery, which passes through it, is one of the commonest seats of aneurism.

SHAPE (Plate XVIII).—It is diamond-shaped; the upper angle lies at the junction of the lower with the middle third of the thigh, and is bounded by the hamstring muscles; the lower is more obtuse, and lies between the outer and inner heads of the gastrocnemius.

The *Roof* is formed by the integuments and by the deep fascia which possesses well-marked transverse fibres (Plate XIX).

The *Lateral Boundaries* should be carefully defined. They are formed thus: on the *outer side* by the biceps above and the outer head of the gastrocnemius and plantaris below (fig. 68); on the *inner side* by the semitendinosus, semimembranosus, gracilis, sartorius above and the inner head of the gastrocnemius below (fig. 68).

The *Floor* is formed by the popliteal surface of the femur, the posterior ligament of the knee-joint, and by the fascia over the popliteus muscle (fig. 69).

Each boundary of the space is now to be defined, the muscles being cleaned one by one. Those in the upper boundaries should be cleaned first, each being followed to its

PLATE XVIII.

THE POPLITEAL SPACE AND ITS CONTENTS.

Muscles.

- A. Biceps.
- B. Semimembranosus.
- C. Semitendinosus.
- D. Gracilis.
- E. Sartorius.
- G. Inner head of gastrocnemius.
- H. Outer head of gastrocnemius.
- J. Plantaris.

Artery.

- 1. Popliteal.

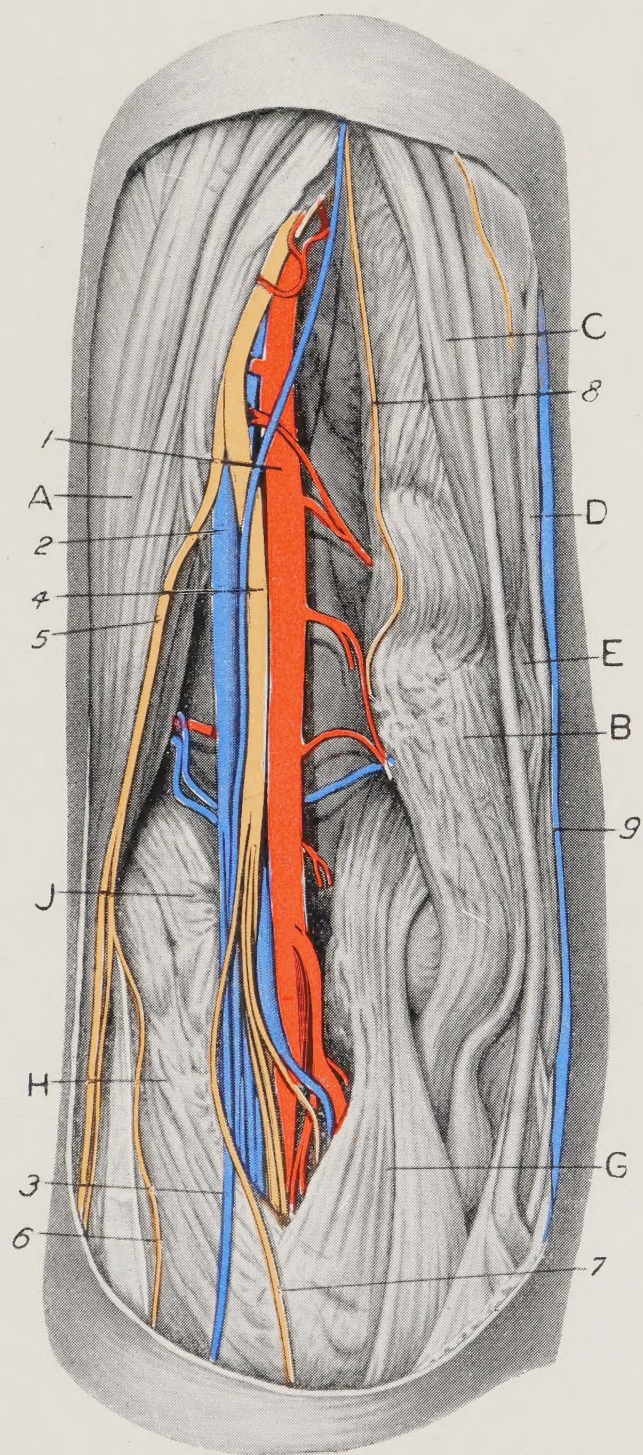
Veins.

- 2. Popliteal.
- 3. External saphenous.
- 9. Internal saphenous.

Nerves.

- 4. Internal popliteal.
- 5. External popliteal.
- 6. Communicans fibularis.
- 7. Communicans tibialis.
- 8. Small sciatic

PLATE XVIII.



insertion. The origins of the heads of the gastrocnemius are deeply placed and require patience in their definition.

Contents (Plates XVIII and XIX).—1. Much *fat* and *connective tissue*. This should be roughly separated with the handle of the knife to see the relative position of the structures imbedded in it.

2. The *Internal and External Popliteal Nerves*, terminal divisions of the great sciatic nerve (fig. 68). They are the most superficial of the chief contents. They give off numerous twigs to the joint and muscles.

3. The *Popliteal Vein*. It is joined by the external saphenous vein (Plate XVIII).

4. The *Popliteal Artery*, the continuation of the femoral. It gives off numerous branches (fig. 69).

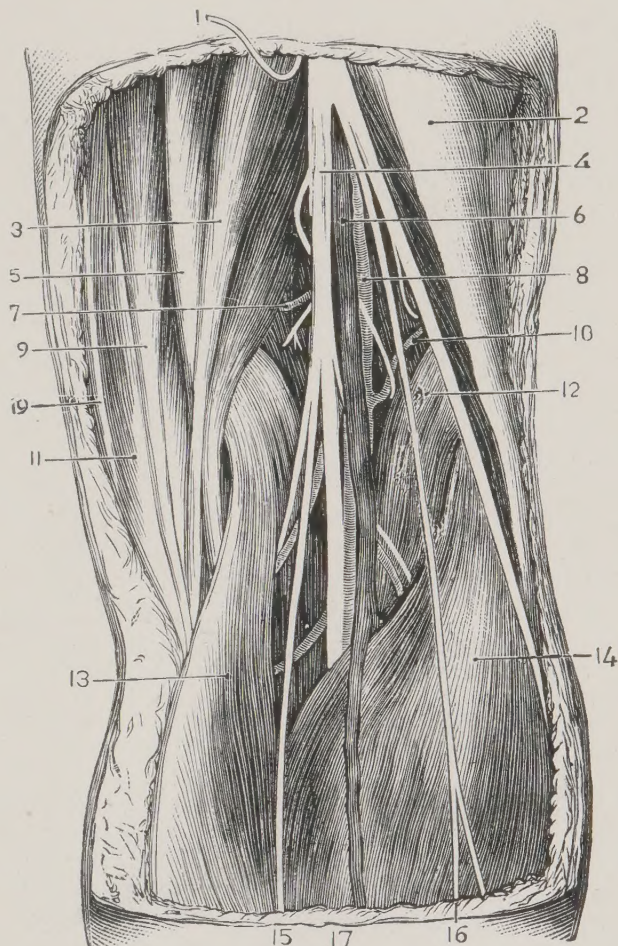
5. The minute *branch of the obturator nerve* to the knee-joint will be found on the superficial aspect of the artery (fig. 68).

6. *Several lymphatic glands*—one between the gastrocnemial heads superficial to the artery and vein, and several deeply placed in the space close to the artery.

7. The terminal branches of the small sciatic nerve have been seen already (Plate XVIII).

Bursæ.—The largest bursa connected with this space lies between the inner head of the gastrocnemius and the tendon of

FIG. 68.—SHOWING THE BOUNDARIES AND CONTENTS OF THE POPLITEAL SPACE. (Heath.)



1. Small sciatic nerve (turned up). 2. Biceps and external popliteal nerve. 3. Semitendinosus. 4. Internal popliteal nerve. 5. Semimembranosus. 6. Popliteal vein. 7. Superior internal articular artery and articular branch of obturator nerve. 8. Popliteal artery. 9. Gracilis. 10. Superior external articular artery and articular nerve. 11. Sartorius. 12. Plantaris. 13. Gastrocnemius, inner head. 14. Gastrocnemius, outer head. 15. Communicans tibialis nerve. 16. Communicans peronei nerve. 17. External saphenous vein. 19. Internal saphenous nerve.

PLATE XIX

DIAGRAMMATIC SECTION OF THE POPLITEAL SPACE, CONDYLES OF THE FEMUR AND PATELLA.

Contents.

1. Popliteal artery.
2. Internal popliteal nerve.
3. Popliteal vein.

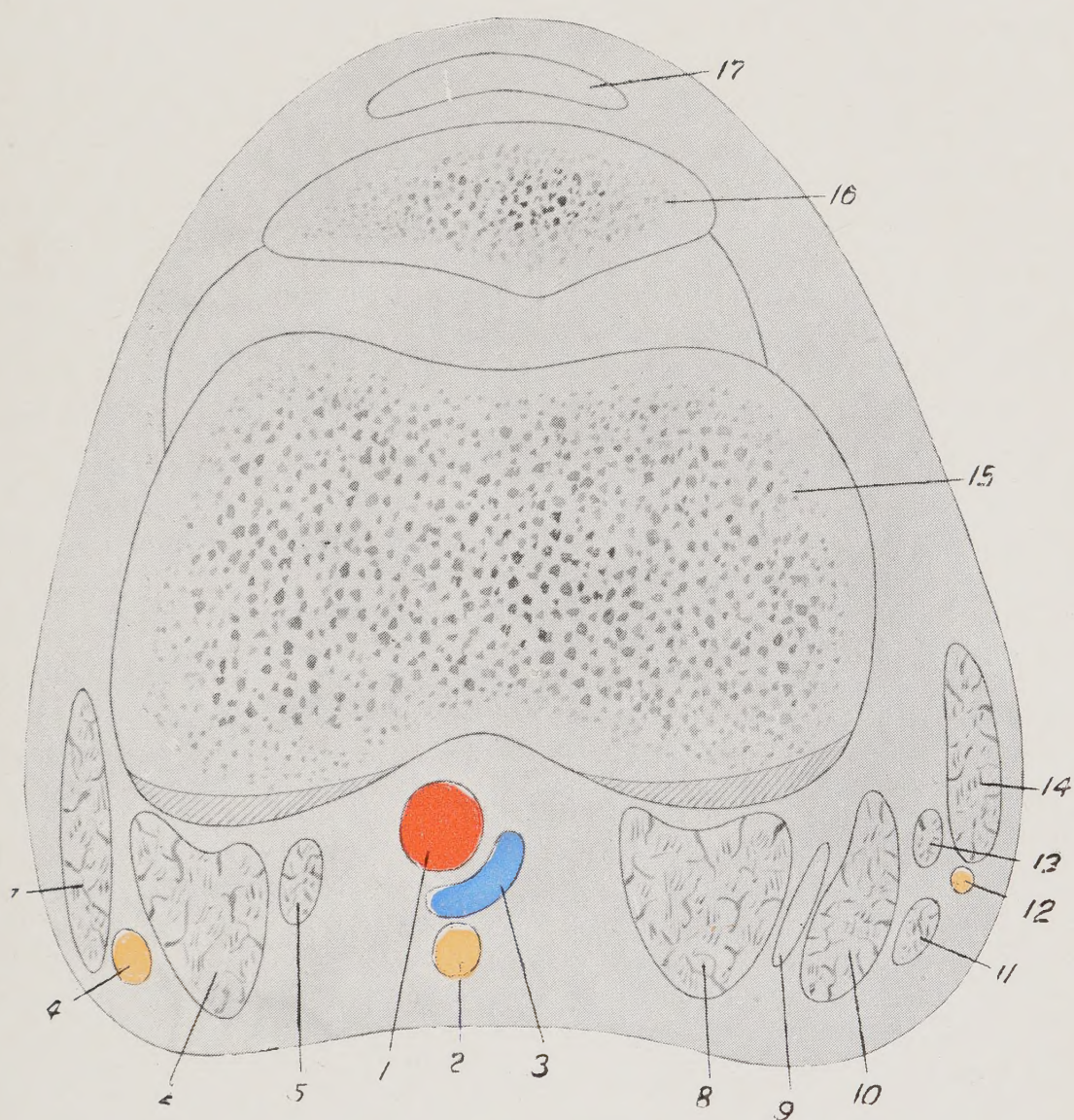
In Outer Boundary.

4. External popliteal nerve.
5. Plantaris.
6. Outer head of gastrocnemius.
7. Biceps tendon.

In Inner Boundary.

8. Inner head of gastrocnemius.
 9. Bursa.
 10. Semimembranosus.
 11. Semitendinosus.
 12. Internal saphenous nerve.
 13. Gracilis.
 14. Sartorius.
-
- | | |
|------------------------|--------------|
| 15. Internal condyle. | 16. Patella. |
| 17. Prepatellar bursa. | |

PLATE XIX.



the semimembranosus. It may be subdivided into loculi and frequently communicates with the cavity of the joint. On the inner aspect of the knee-joint other bursæ are found beneath the insertions of the sartorius, gracilis, semitendinosus, and the semimembranosus. On the outer side of the joint, a bursa is found beneath the tendon of the biceps, and one occasionally occurs under the outer head of the gastrocnemius.

The Popliteal Nerves (figs. 63, 68, and Plate XVIII).—Before it reaches the popliteal space the Great Sciatic Nerve splits into the External and Internal Popliteal Nerves.

The **External Popliteal Nerve** passes downwards in the outer side of the space, quite close to the tendon of the biceps. In the living, the tendon is the best guide to the nerve. As it leaves the depression between the outer head of the gastrocnemius and the biceps tendon, the external popliteal nerve pierces the origin of the peroneus longus (fig. 97). As it pierces, it divides into two branches, the anterior tibial and musculo-cutaneous. Through these it is distributed to the skin and muscles on the extensor aspect of the leg and foot.

The nerve crosses the outer aspect of the shaft of the fibula, just below the head of that bone. It is there liable to compression from the application of tight bandages or garters.

BRANCHES.—(a) A branch to the short head of the biceps.

(b) Two branches to the knee-joint. They are minute twigs and not easily dissected out.

(c) The recurrent articular branch to the knee-joint. It accompanies the anterior tibial nerve, and is buried in the origins of the extensor muscles below the knee.

(d) The *communicans peronei* (figs. 68 and 97), a considerable nerve which joins below the calf with a corresponding branch from the internal popliteal to form the external saphenous nerve.

(e) A cutaneous branch to the skin on the outer aspect of the upper part of the leg.

The **Internal Popliteal Nerve** (Plate XVIII) passes downwards in the centre of the space. It passes beneath the muscles of the calf, and at the lower border of the popliteus muscle becomes the posterior tibial nerve.

BRANCHES.—(a) Three articular branches to the knee-joint. They are small twigs which accompany the articular arteries

PLATE XX.

DISSECTION OF THE OUTER ASPECT OF THE KNEE-JOINT.

Muscles.

- A. Biceps.
- B. Outer head of gastrocnemius.

Ligaments.

- C. External lateral.
- D. Posterior fasciculus of external lateral.

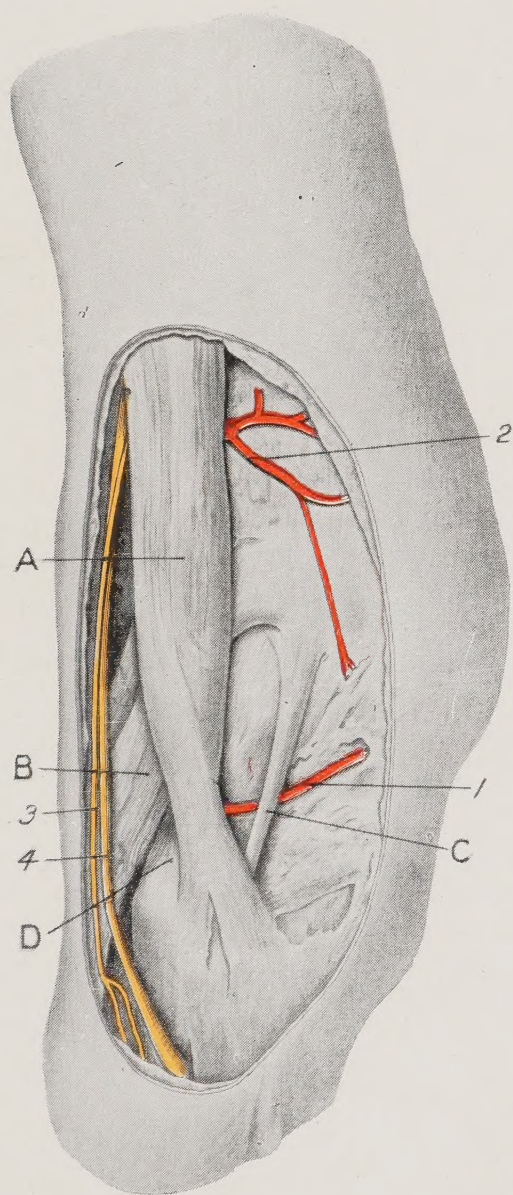
Arteries.

- 1. External inferior articular.
- 2. External superior articular.

Nerves.

- 3. Communicans peronei.
- 4. External popliteal.

PLATE XX.



to the inner side of the joint. One pierces the posterior ligament with the azygos artery.

(b) Numerous branches to the gastrocnemius and soleus muscles.

(c) A branch to the popliteus, which will be found turning round the lower border of that muscle to enter its deep surface.

(d) The *communicans tibialis* (fig. 68) passes with the external saphenous vein between the two heads of the gastrocnemius and joins with the *communicans peronei* to form the external saphenous nerve. It is of variable size.

The *External Saphenous Vein* should be traced to its termination in the popliteal vein (Plate XVIII).

The **Popliteal Vein** and its branches should be cleaned and dissected completely away. It is so closely applied to the superficial aspect of the artery that its removal is difficult. It is formed in the lower part of the popliteal space by the union of the *venæ comites* of the posterior and anterior tibial arteries; above, it pierces the adductor magnus with the artery and forms the femoral vein. In the lower part of the space it is situated rather to the inner side of the artery, and in the upper part, to its outer aspect. Veins corresponding to the branches of the popliteal artery join it.

The **Popliteal Artery** and its branches require careful cleaning. The artery is the continuation of the femoral and extends from the opening in the adductor magnus to the lower border of the popliteus muscle (fig. 69). There it divides into the anterior and posterior tibial arteries.

At first it lies under the semimembranosus; in the popliteal space it is covered by the internal popliteal nerve and popliteal vein, which is closely applied to the artery. The vein and nerve are external to the artery above, but become internal to it below. The geniculate branch of the obturator nerve perforates the adductor magnus and proceeds downwards on the artery to the knee-joint (fig. 68). In the lower part of the popliteal space the artery lies under the gastrocnemius muscle. The artery rests on the floor of the space, viz. popliteal surface of the femur, posterior ligament of the joint, and the fascia over the popliteus muscle.

The student will note that the popliteal artery may be exposed as it enters the upper part of the space by separating the

PLATE XXI.

DISSECTION OF THE INNER ASPECT OF THE KNEE-JOINT.

Muscles.

- A. Vastus internus.
- B. Sartorius.
- C. Gracilis.
- D. Semitendinosus.
- E. Tendon of adductor magnus.

Ligament.

- F. Internal lateral.

Arteries.

- 1. Deep branch of anastomotica magna.
- 2. Inferior internal articular.

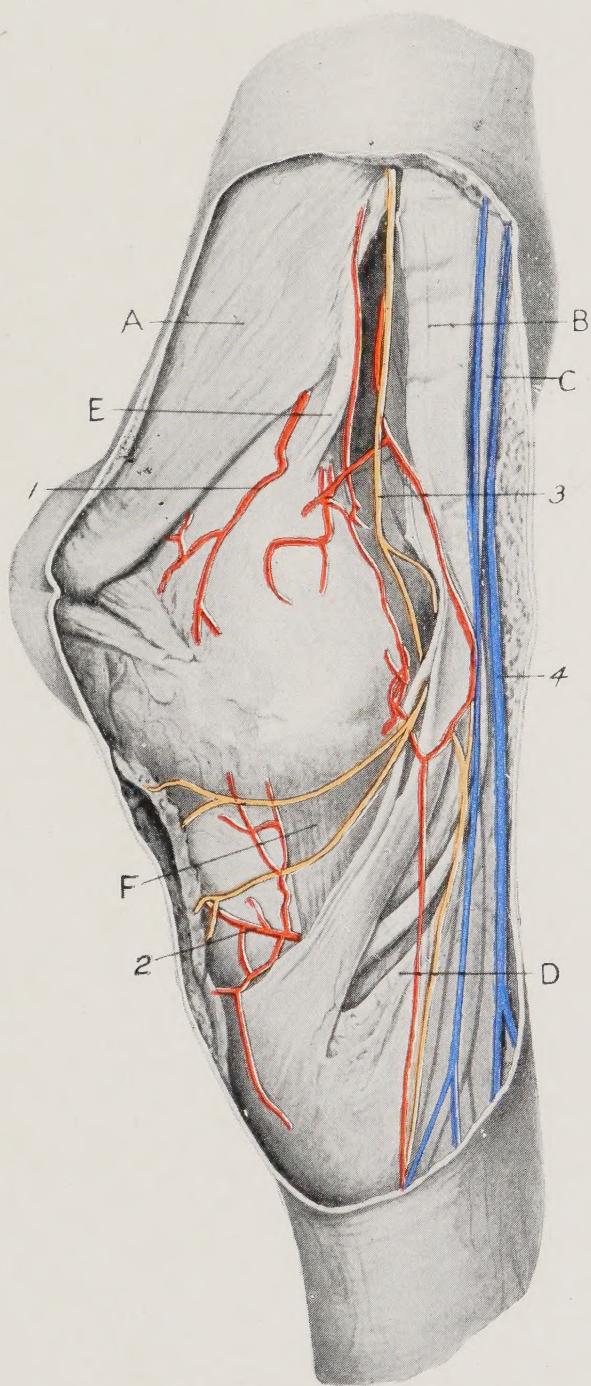
Nerve.

- 3. Patellar branch of internal saphenous.

Vein.

- 4. Internal saphenous.

PLATE XXI



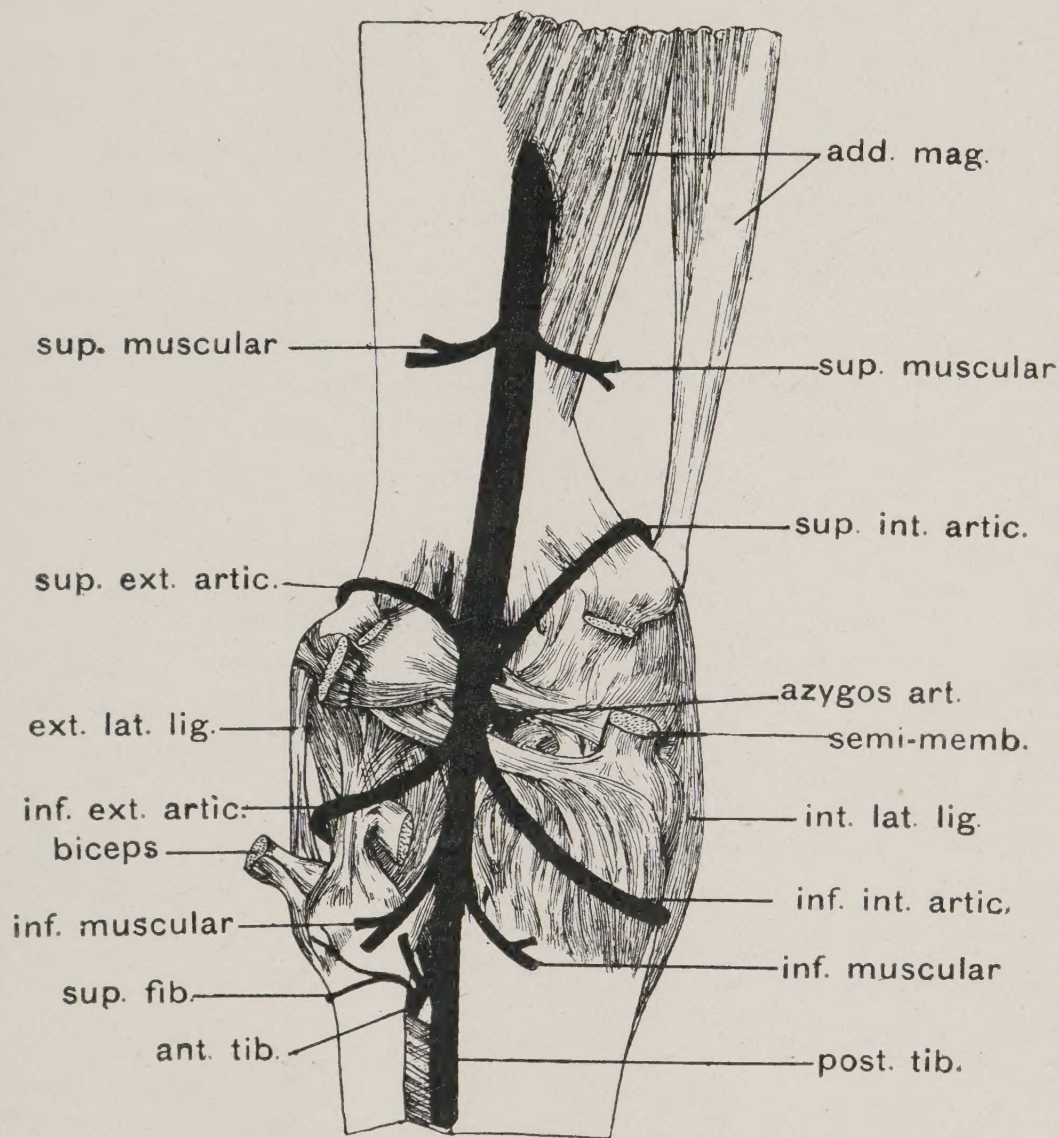
semimembranosus from the adductor magnus. The surgeon may select this route in tying the artery.

BRANCHES.—These are cutaneous, muscular, and articular.

(1) A *cutaneous* branch accompanies the short saphenous vein to the back of the leg.

(2) *Muscular* branches are supplied to the hamstring

FIG. 69.—DIAGRAM OF THE POPLITEAL ARTERY AND OF ITS BRANCHES.
(H. Balean.)



muscles. Several large branches, the *sural arteries*, pass to the muscles of the calf.

(3) The *articular* branches (fig. 69) are five in number: two superior (internal and external), two inferior (internal and external), and an azygos or middle branch.

(a) The *superior internal articular artery* winds close to the femur above the condyle and underneath the tendon of the

adductor magnus and inner hamstrings. It anastomoses with the deep branch of the anastomotica magna, and shares in the general arterial anastomosis (peri-articular plexus) around the knee-joint.

(b) The *superior external articular artery* winds outwards under the biceps muscle. It anastomoses with the descending branch of the external circumflex artery.

(c) The *inferior internal articular artery* passes obliquely downwards underneath the inner head of the gastrocnemius. It pierces the fascia over the popliteus, and reaches the front of the knee-joint by passing under the internal lateral ligament. It joins the general anastomosis around the knee-joint.

(d) The *inferior external articular artery* passes transversely outwards under the outer head of the gastrocnemius, and, reaching the outer side of the knee, it passes above the head of the fibula and beneath the tendon of the biceps and the external lateral ligament. Having reached the front of the knee, it joins the general arterial network of the joint. Many of its twigs anastomose with the recurrent branch of the anterior tibial artery.

(e) The *azygos articular* branch pierces the posterior ligament of the joint, and ends in the crucial ligaments and synovial membrane.

The hamstring muscles are now to be detached, one by one, their origins and insertions being again examined. Only the terminal parts of the muscle need be left at the knee-joint. The branches of the deep femoral artery which perforate the adductor magnus require to be cut as they enter the hamstring muscles.

The **Adductor Magnus** is now displayed on its posterior aspect, which should be cleaned (fig. 67). The following points should be verified :

(1) That the muscle forms a great internal septum in the thigh (fig. 84).

(2) That the fibres which arise most posteriorly from the ischium pass downwards and end in a tendon which is inserted to the adductor tubercle of the femur. This part is supplied from the great sciatic nerve.

(3) That at its insertion to the linea aspera of the femur there are fibrous arches through which the perforating arteries pass (fig. 67).

By the time the student has completed this dissection, he will find that the dissectors of other regions require the body to be turned. He is now to examine the structures of the groin and front of the thigh. If, however, he has failed to finish the dissection of this region, it must be completed after the front of the thigh has been examined.

DISSECTION IV

FRONT OF THE THIGH

The body is placed on its back ; the pelvis is raised by inserting two blocks beneath it ; the lower extremities are stretched out at full length on the table. Before proceeding to the dissection of the groin and the superficial structures in front of the thigh (Dissection IV) it is necessary to examine the surface markings of the thigh.

The crest of the ilium, Poupart's ligament, the rami of the pubes and ischium are the limits which separate the regions of the thigh and abdomen. When examining these structures and in the dissection of the groin, the dissectors of the lower extremity must work in common with the dissectors of the abdomen.

Surface Markings.—The student should place an articulated pelvis and femur alongside his part and proceed to verify the following points. The crest of the ilium should be felt terminating in front in the *anterior superior spine*, to which the outer end of Poupart's ligament is attached. The finger should be passed along this ligament to the *spine of the os pubis*, which is an important bony landmark in this region. Above the spine is a depression corresponding to the external abdominal ring, through which an inguinal hernia may emerge (fig. 70). Below and external to it is the femoral ring, through which a femoral hernia enters the thigh (fig. 78).

Internal to the pubic spine, the crest and body of the os pubis can be felt. In the male the spermatic cord can be distinguished, extending from the external abdominal ring towards the scrotum. The finger should next be passed backwards to the tuberosity of the ischium, along the rami of the os pubis and ischium, which form here the boundary between the inner side

immediately below it. Below and *behind* this is the head of the fibula with the tendon of the biceps passing to it (Plate XX). In front of the tendon the ilio-tibial band may be traced to the outer tuberosity of the tibia.

On the inner side of the joint feel the prominent inner condyle with the adductor tubercle at its upper and posterior part (Plate XXI). The tendon of the adductor magnus can be traced to this tubercle, a valuable surgical guide. Behind the condyle the group of inner hamstring tendons can be felt (fig. 68). Above the inner tuberosity of the tibia a slight notch, best felt in the flexed position, indicates the line of the knee-joint. The position of the femoral artery is indicated thus: the thigh is slightly flexed and abducted; a point (the mid-inguinal), taken midway between the symphysis pubis and anterior superior iliac spine, indicates the position of the femoral artery as it escapes from the abdomen to the thigh beneath Poupart's ligament (fig. 70). A line is then drawn from the mid-inguinal point to the adductor tubercle above the internal condyle of the femur. The upper two-thirds of this line mark the position of the femoral artery. At the junction of the middle and lower thirds of the line, the femoral artery perforates the adductor magnus and becomes the popliteal (fig. 69).

The Superficial Structures of the Groin and Thigh.—DISSECTION.—In order to expose the superficial structures on the front of the thigh and groin, three incisions should be made:

- (1) An oblique incision along Poupart's ligament.
- (2) A transverse incision below the patella.
- (3) A vertical incision passing down the middle of the thigh in front, connecting these two. The two flaps of skin thus marked out are to be raised outwards and inwards.

The *Pre-patellar Bursa* (fig. 98, 11) lies in the tissue between the skin and lower half of the patella or knee-cap. The bursa is easily displayed by a vertical incision in the subcutaneous tissue over the patella and ligamentum patellæ. The bursa allows the skin to glide freely over the patella when the knees are in contact with the ground. It frequently enlarges in those who kneel much. Numerous septa will be found crossing the bursal space, which may divide it partially or completely into superficial and deep compartments.

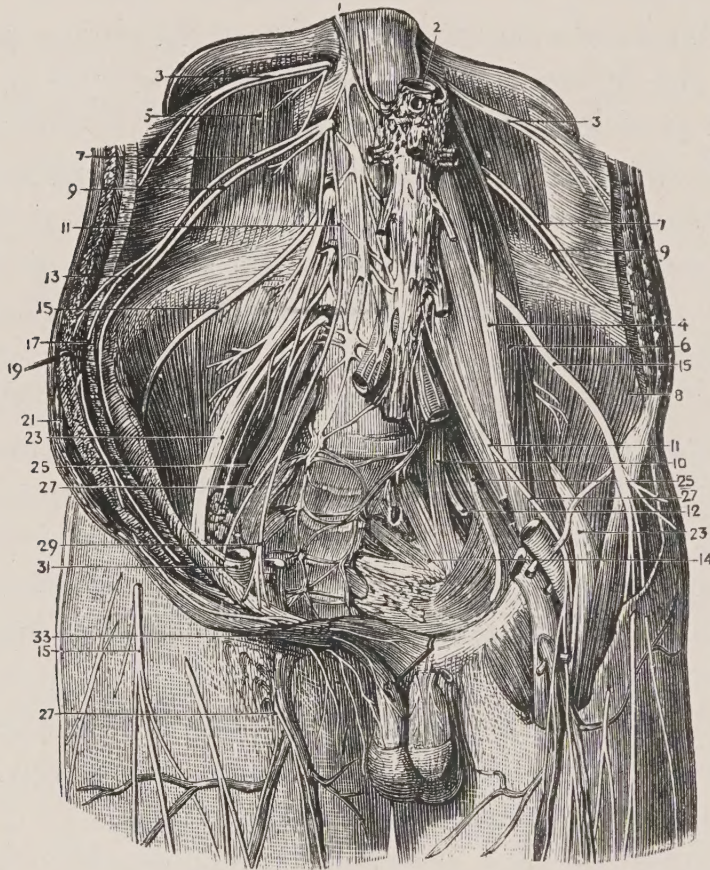
SUPERFICIAL STRUCTURES.—In searching for the structures which lie in the superficial fascia between the skin and

the deep fascia, the dissector will find a free use of the knife-handle of the greatest service.

(1) In the fascia near the upper and inner angle of the area exposed will be found the *ilio-inguinal nerve* (fig. 71).

(2) Near the upper and outer angle is a ridge beneath which the *external cutaneous nerve* lies (fig. 71).

FIG. 71.—SHOWING THE LUMBAR PLEXUS AND THE SUPERFICIAL NERVES OF THE GROIN. (*Hirschfeld and Leveillé.*)



Right gangliated cord of sympathetic. 2. Abdominal aorta. 3, 3. Last dorsal nerves. 4. Psoas parvus. 5. Quadratus lumborum. 6. Psoas magnus. 7, 7. Ilio-hypogastric nerves. 8. Iliacus. 9, 9. Ilio-inguinal nerve. 10. Lumbo-sacral cord. 11, 11. Genito-crural nerves. 12. Gluteal nerve. 13. Iliac branch of ilio-hypogastric nerve. 14. Sacral plexus. 15, 15. External cutaneous nerves. 17. Transversalis abdominis. 19. Obliquus internus. 21. Obliquus externus. 23, 23. Anterior crural nerves. 25, 25. Obturator nerves. 27, 27. Crural branch of genito-crural nerve. 29. Genital branch of genito-crural nerve. 31. External iliac artery. 33. External abdominal ring.

(3) About the middle of the thigh one or two branches of the *middle cutaneous nerve* will be found (fig. 71).

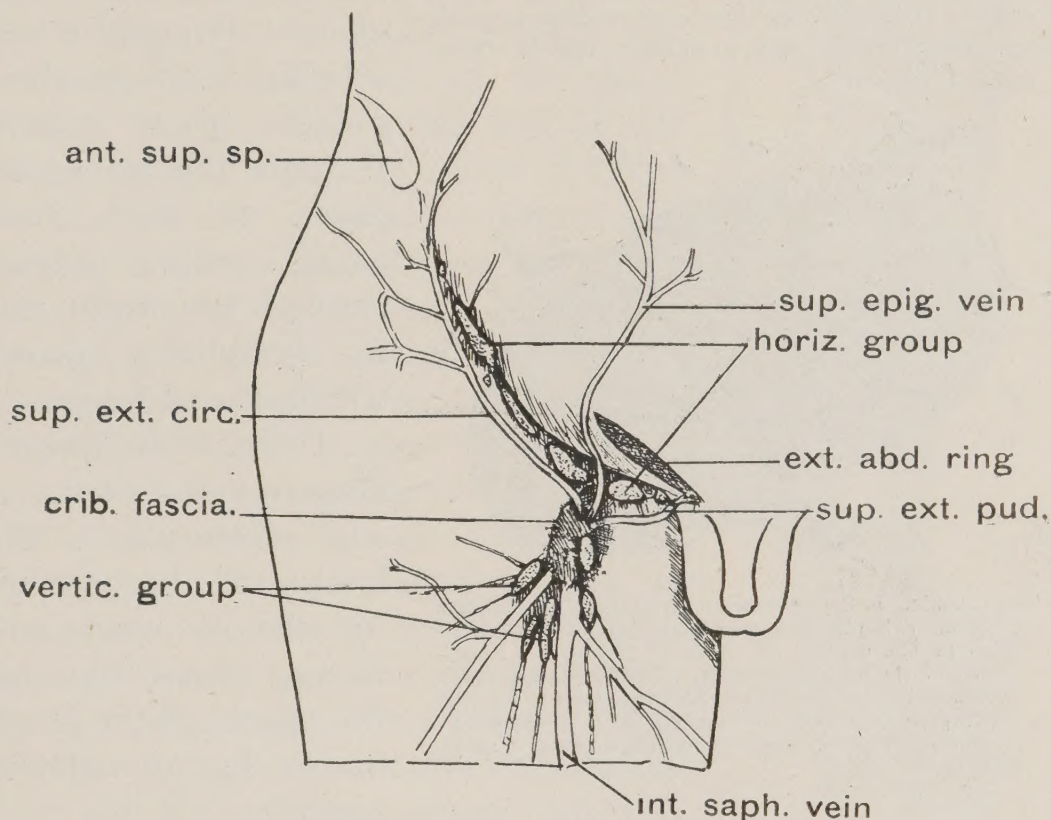
(4) The *internal cutaneous* becomes superficial towards the inner side of the thigh below its middle (fig. 76) and close to the inner border of the sartorius.

(5) Passing up towards the inner third of Poupart's ligament will be found the *long saphenous vein* (fig. 74). The vein sinks into a deficiency in the deep fascia, viz. the *saphenous*

opening, and joins the femoral vein. Across the opening a layer of loose fascia, which is pierced by the vein and some lymphatic vessels, is seen to extend. This is the *cribriform fascia*. By scraping this away with the handle of the scalpel, the outer or falciform border of the saphenous opening can be defined (fig. 78).

(6) *Scarpa's fascia* is a transverse septum which binds the superficial fascia of the groin to the deep fascia of the thigh. It is attached to the deep fascia, along the line of the groin, from the pubic almost to the anterior superior spine, half an

FIG. 72.—THE SUPERFICIAL LYMPHATIC GLANDS OF THE GROIN.



inch below the line of Poupart's ligament. The dissectors of the abdomen will demonstrate its connections. It is usually described as a deep layer of the superficial fascia of the abdomen.

(7) The *inguinal lymphatic glands* (fig. 72).

(8) The *superficial inguinal vessels* (fig. 72).

(9) The *deep fascia* of the thigh (fig. 74).

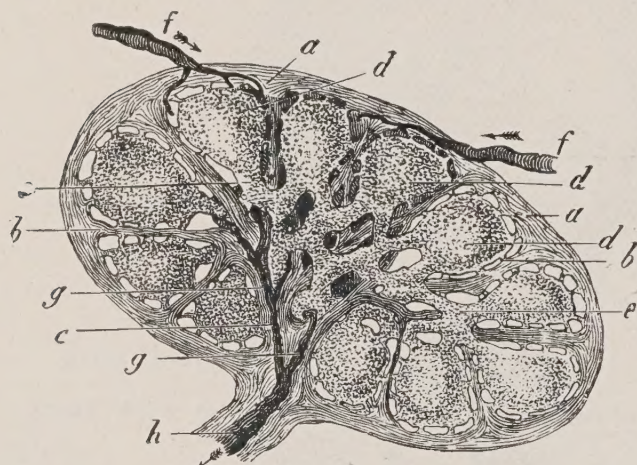
Superficial Inguinal Glands (fig. 72).—These consist of two sets :

(1) An upper oblique or *inguinal* set lying close to Poupart's

ligament. Its glands receive the superficial lymphatics (*a*) of the genital region, hence are liable to become inflamed in venereal affections; (*b*) of the lower part of the abdominal wall; and (*c*) of the outer part of the gluteal region.

(2) An irregular vertical group of *femoral* glands receiving the superficial lymphatics of the lower extremity. This set surrounds the terminal stage of the internal or long saphenous vein. The afferent lymphatic vessels accompany the vein and drain a corresponding area (fig. 74). Hence sores situated so far distant as on the inner side of the foot give rise to inflammation

FIG. 73.—A DIAGRAMMATIC SECTION OF A LYMPH GLAND, SHOWING THE AFFERENT LYMPH VESSELS ENTERING IT AND THE EFFERENT VESSEL LEAVING. (*Wilson.*)



a. The capsule. *b.* Septa between the alveoli of the cortical portion. *c.* Septa of the medullary portion, down to the hilus of the organ. *d.* Adenoid tissue. *e.* Lymph vessels of the medullary mass. *f.* Different lymphatic streams which surround the follicles, and flow through the interstices of the medullary portion. *g.* Confluence of these passing through the efferent vessel, *h*, at the hilus of the organ.

of the femoral set of inguinal glands. The efferent lymphatic vessels (fig. 73) from these glands pass mainly through the cribriform fascia to the crural canal, and thence through the crural ring to lymphatic glands within the abdomen.

In fig. 73 is shown a diagrammatic section of a lymphatic gland. The lymph is brought in by afferent vessels and, having passed through the spaces of the gland, leaves by an efferent vessel.

Superficial Vessels of the Groin (fig. 72).—The three following *small* arteries arise from the femoral artery just below Poupart's ligament and reach the surface by piercing either the fascia lata or cribriform fascia. They are often very small, and not infrequently one or other of them may be absent.

(1) The *superficial epigastric artery* passes upwards over Poupart's ligament towards the umbilicus, supplying superficial structures in the lower half of the abdomen. The accompanying vein is usually more apparent than the artery.

(2) The *superficial circumflex iliac artery* passes outwards

below Poupart's ligament towards the gluteal region. It supplies the lymphatic glands.

(3) The *superficial external pudic artery* passes towards the pubes supplying the skin of the scrotum and penis. It reaches the prepuce in the male and the labia in the female. In the male it crosses the spermatic cord.

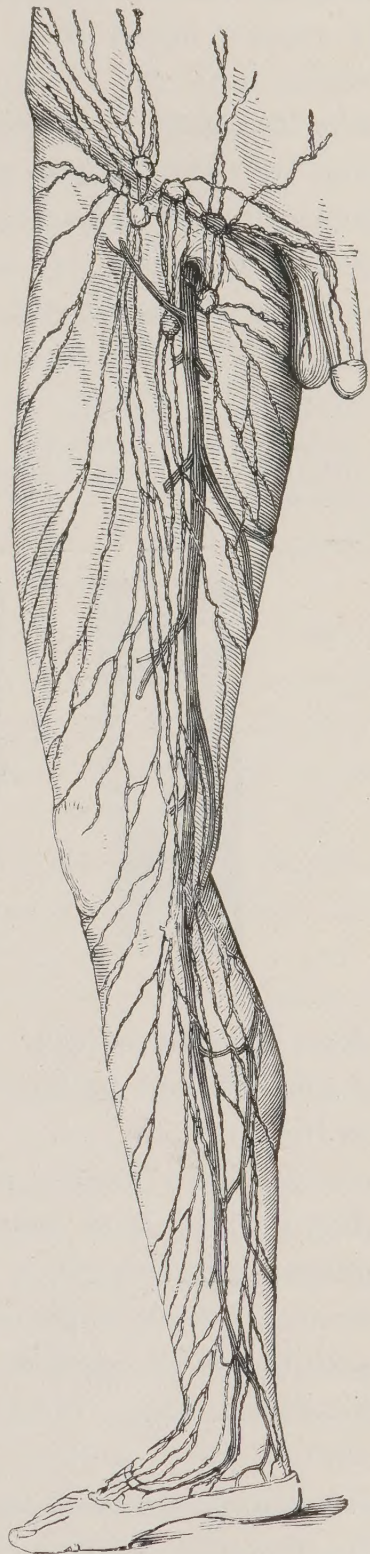
The *veins* corresponding to these arteries enter the long saphenous vein near the saphenous opening.

The **Long or Internal Saphenous Vein** (fig. 74) is easily cleaned and defined. It commences at the inner side of the dorsum of the foot in the dorsal venous arch. It leaves the foot in front of the internal malleolus, and having passed upwards on the inner side of the leg and knee, it inclines forwards on the inner side of the thigh to disappear through the saphenous opening and terminate in the femoral vein.

Just before piercing the cribriform fascia it receives small veins corresponding to the superficial arteries of the groin, and usually an *accessory* or *anterior saphenous* branch from the front of the thigh. The lower reaches of the vein and its tributaries about the knee and leg are apt to become varicose. When such a patient stands, the whole course of the vein from foot to groin is marked by tortuous dilatations. Part of the vein should be laid open and the valves within it examined (fig. 75). When the veins become varicose the valves cease to be competent and allow the blood to regurgitate.

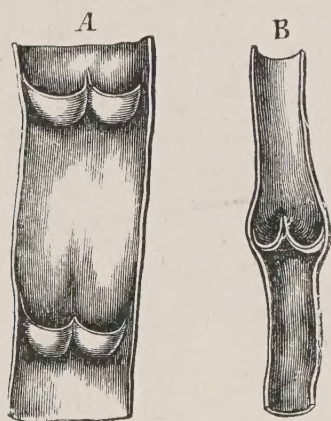
Cutaneous Nerves (fig. 76).—The positions of these nerves have been already indicated. Each must now be found, cleaned, and examined.

FIG. 74.—THE INTERNAL OR LONG SAPHENOUS VEIN WITH ACCOMPANYING LYMPHATIC VESSELS. (Wilson.)



(1) The *external cutaneous nerve* (from second and third lumbar nerves, fig. 71) enters the thigh from the iliac fossa below the outer end of Poupart's ligament and over the sartorius muscle. It passes down in a tube of the fascia lata (fig. 76) and divides into a *posterior* branch to the skin of the lower part of the buttock and adjacent region of the thigh, and a much larger *anterior branch* to supply the

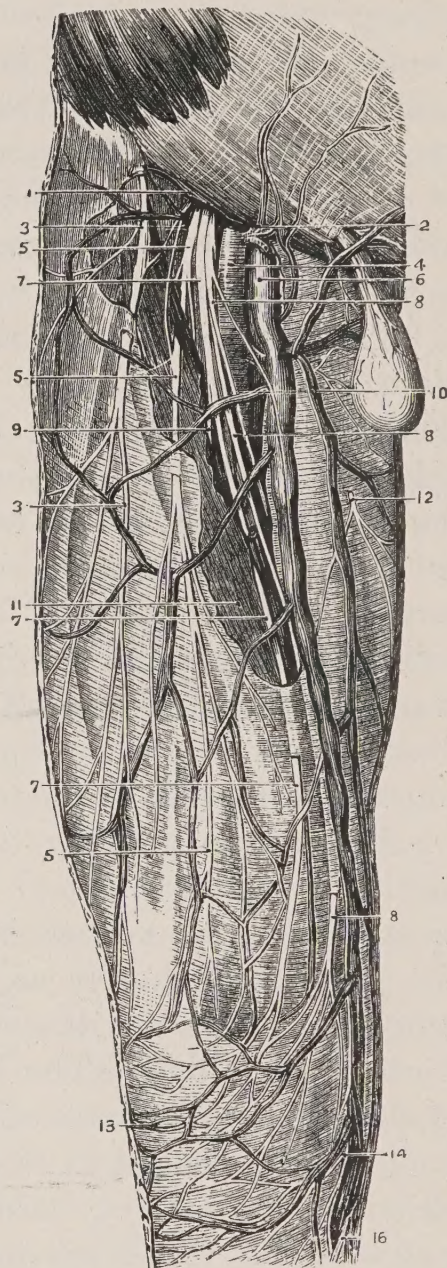
FIG. 75.—A. A PART OF A VEIN LAID OPEN, WITH TWO PAIRS OF VALVES. B. LONGITUDINAL SECTION OF A VEIN, SHOWING THE VALVES CLOSED. (Wilson.)



skin on the outer side of the thigh. Some twigs reach as far as the knee.

(2) The *genito-crural nerve* (from first and second lumbar nerve, fig. 71) gives off a *crural* branch which supplies an area of skin below the middle of Poupart's ligament (fig. 71). It appears about two inches below that structure external to the line of the femoral artery. It communicates with one of the branches of the middle cutaneous nerve. It is frequently small, and often

FIG. 76.—THE CUTANEOUS NERVES OF THE EXTENSOR ASPECT OF THE THIGH. (Hirschfeld and Leveillé.)



1. Poupart's ligament. 2. Superficial branches of femoral artery. 3, 3. External cutaneous nerve. 4. Femoral artery. 5, 5, 5. Middle cutaneous nerve. 6. Femoral vein. 7, 7, 7. Anterior division of internal cutaneous nerve. 8, 8, 8. Posterior division of internal cutaneous nerve. 9. Branch to sartorius from middle cutaneous. 10. Saphenous vein. 11. Sartorius. 12. Cutaneous branch of obturator nerve. 13. Plexus patellæ. 14. Patellar branch of long saphenous nerve. 16. Long or internal saphenous nerve.

difficult to find unless traced from its origin within the abdomen.

(3) The *ilio-inguinal nerve* (from first lumbar nerve, fig. 71) appears through the external abdominal ring below the spermatic cord and supplies the skin of the scrotum or labium and adjacent part of the thigh.

(4) The *middle cutaneous nerve*, a branch of the anterior crural, pierces the deep fascia at the inner border of the sartorius muscle, as two branches, one of which usually pierces that muscle (fig. 76). They extend as far as the knee and end in the patellar plexus.

(5) The *internal cutaneous nerve* (also from the anterior crural) passes downwards and inwards over the femoral artery to the apex of Scarpa's triangle (fig. 76). There it divides into an *anterior branch* which passes to the patellar plexus, and a *posterior* which passes down on the inner side of the knee to the skin of the upper third of the leg. A small branch supplies the skin on the inner aspect of the thigh above.

(6) The *long or internal saphenous nerve* (fig. 77), also a branch of the anterior crural nerve, lies deeply in the thigh close to the femoral artery, which it accompanies through Hunter's canal. Near the knee it becomes superficial at the posterior border of the sartorius, and, having given off a *patellar branch* which pierces the sartorius to reach the patellar plexus (fig. 76, 14), it is continued downwards with the long saphenous vein to the inner side of the foot.

Patellar Plexus.—The skin over and around the patella is supplied from the patellar plexus, which is formed by terminal branches of the internal, middle, and external cutaneous and patellar branches of the long saphenous nerves.

Subsartorial Plexus.—Beneath the middle of the sartorius communications will be found subsequently between branches of long saphenous, internal cutaneous, and obturator nerves (fig. 77).

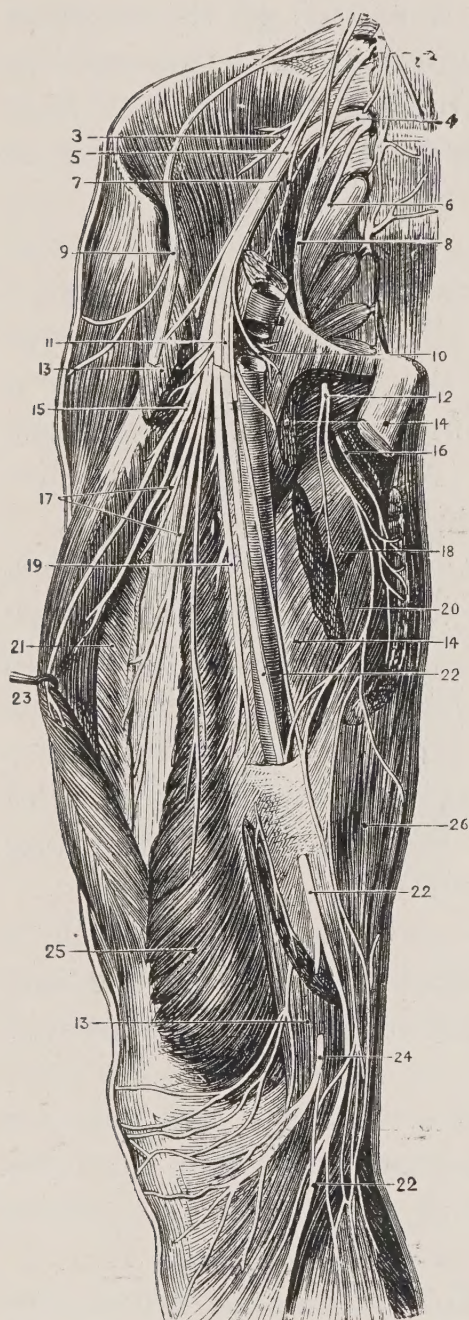
An *occasional branch* of the obturator may be found supplying the skin over the middle of the thigh on the inner side (fig. 77).

Fascia Lata.—All the superficial structures, nerves, vessels, and glands are to be removed, and the deep fascia exposed and cleaned.

The fascia lata forms an aponeurotic sheath which encloses

the muscles of the thigh (figs. 76 and 84, 6). Were it not for such a binding the muscles of the thigh would hang as loose

FIG. 77.—SHOWING THE BRANCHES OF THE ANTERIOR CRURAL AND OBTURATOR NERVES. (Hirschfeld and Leveillé.)



1. Gangliated cord of sympathetic. 2. Third lumbar nerve. 3. Branches to iliacus internus. 4. Fourth lumbar nerve. 5. Anterior crural nerve. 6. Lumbo-sacral nerve. 7. Branch to psoas. 8. Obturator nerve. 9. External cutaneous nerve (cut). 10. Nerve to pectineus. 11. Superficial division of anterior crural nerve (cut). 12. Superficial division of obturator nerve. 13, 13. Sartorius muscle. 14, 14. Adductor longus. 15. Branch to rectus. 16. Deep division of obturator nerve. 17. Branches to vastus internus and crureus. 18. Adductor brevis. 19. Branch to vastus internus. 20. Adductor magnus. 21. Vastus externus. 22, 22. Internal saphenous nerve. 23. Rectus femoris. 24. Patellar branch of saphenous nerve. 25. Vastus internus. 26. Gracilis.

straps. Further, it adds greatly to the strength of the thigh. In conditions where the veins are greatly distended, the surgeon applies an elastic bandage to the part to prevent further dilatation of the vessels. The fascia lata acts as a natural bandage, for it must be remembered that the blood-vessels of the lower extremity, owing to the action of gravity, are subject to a greater pressure than the vessels of other parts.

It is attached above to the pelvic girdle. Its attachment can be traced to the os pubis, to Poupart's ligament, to the outer lip of the iliac crest, to the side of the sacrum and coccyx, and to the rami of the pubes and ischium and ischial tuberosity. In the interval between the coccyx and tuberosity, the fascia dips underneath the gluteus maximus to be attached to the great sacro-sciatic ligament.

In the region of the knee the fascia is attached partly to the borders of the patella, ligamentum patellæ, and subcutaneous surfaces of the tibial tuberosities and head of the fibula, and

assists to form the capsule of the knee-joint in front. It forms the fascia over the popliteal space and becomes continuous with that of the leg.

Intermuscular septa pass from the deep surface of the fascia lata between the muscles of the thigh (fig. 84, p. 184). Two of these are well marked above the knee. The internal intermuscular septum passes to the inner lip of the linea aspera, between the vastus internus and adductor muscles, while the external septum dips in between the vastus externus and the biceps to reach the outer lip of the linea aspera.

On the inner side of the thigh, the fascia lata is very thin, but on the outer side it is considerably thickened to form a strap-like band, the *ilio-tibial band*. This band of the deep fascia gives insertion to the greater part of the gluteus maximus and tensor fasciæ femoris, and is attached below to the outer tuberosity of the tibia and head of the fibula. It acts as a tense supporting band to the outer side of the knee-joint during extension. In balancing the body on the leg, as in walking, these muscles act from the leg as their fixed point. Traced upwards, the ilio-tibial band will be found to split near the great trochanter into two layers, which receive between them the insertion of the tensor fasciæ femoris. The *superficial layer* extends upwards to the anterior part of the outer lip of the crest of the ilium. The *deep layer* passes under the tensor fasciæ, close to the tendon of the rectus femoris, to reach and fuse with the capsule of the hip-joint. This deep layer is pierced by the ascending branch of the external circumflex artery on its way to the buttock. Several openings for superficial blood-vessels and cutaneous nerves are found in the fascia lata; one is of large size, viz. the *saphenous opening* for the long saphenous vein, and needs special description.

The **Saphenous Opening** is an oblique hiatus situate immediately below the inner third of Poupart's ligament (fig. 78). On the inner side of this opening the *pubic portion* of the fascia covers the pectineus muscle, and is continued upwards on the surface of that muscle, *under* the femoral sheath and vessels, as far as the ilio-pectineal line (fig. 78).

Externally, the *iliac portion* of the fascia lata forms a free crescentic edge, the *falciform ligament*, frequently very indistinctly marked. It ends in two cornua.

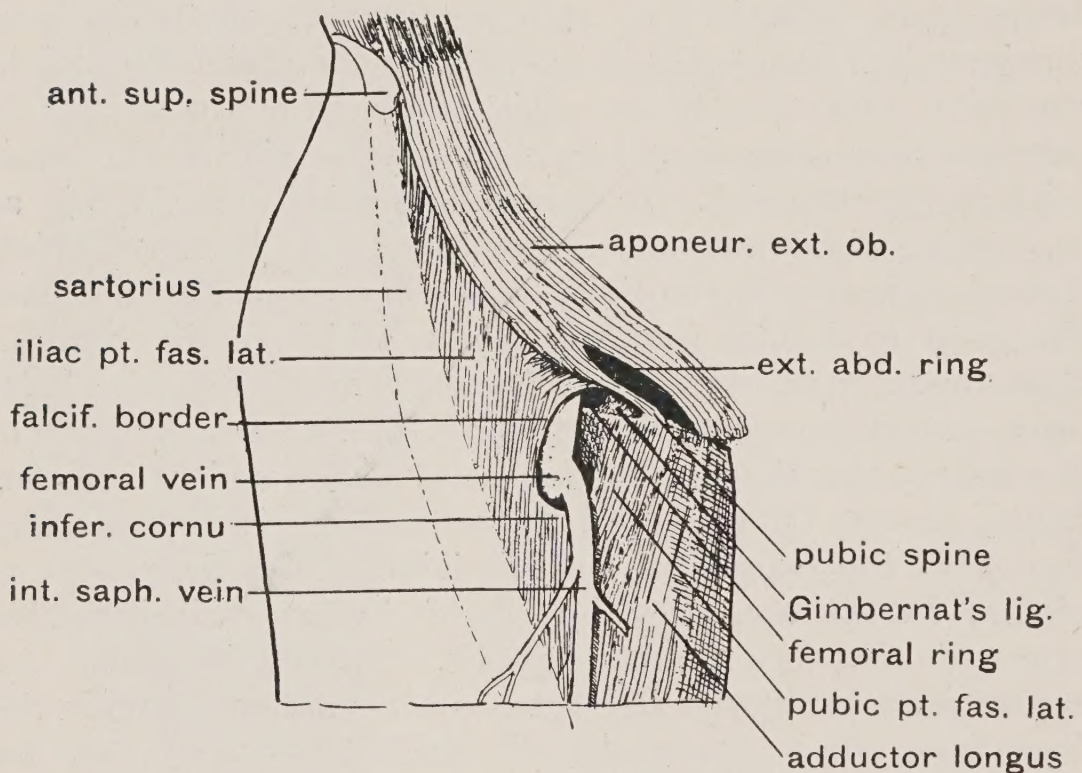
The *inferior cornu* lies beneath the termination of the long

saphenous vein and joins the pubic portion. The *superior cornu* (Hey's ligament) arches inwards over the femoral vessel to join Poupart's and Gimbernats ligaments (fig. 78).

Stretching across and closing the saphenous opening is the thin 'sieve-like' *cribriform fascia*, which is perforated at its lower part by the long saphenous vein and superficial inguinal vessels. Lymphatic vessels also pierce the cribriform fascia on their way from the superficial inguinal glands to the crural canal.

The saphenous opening is of importance because when any of the abdominal contents escape beneath Poupart's ligament,

FIG. 78.—THE SAPHENOUS OPENING AND GIMBERNAT'S LIGAMENT.



the femoral hernia thus formed rises outwards through it, turning round the falciform border and upper cornu of the opening. Hence it is important to note that the outer or falciform border and upper cornu are rendered tense in extension of the limb, and relaxed in flexion with adduction, a position in which the reduction of a hernia is facilitated.

The Crural Passage (fig. 79).—Poupart's ligament passes from the anterior superior spine of the ilium to the spine of the pubes and bridges over the crural passage, a space between the ligament and the pelvis. A fibrous septum passes from Poupart's

ligament to the ilio-pectineal eminence, and divides the passage into an *outer* or *muscular* and *inner* or *vascular* compartment.

Through the *outer compartment* the following structures pass from the abdomen to the thigh (see fig. 79). These structures will be seen by detaching the fascia lata from Poupart's ligament (fig. 80) :

1. The external cutaneous nerve ;
2. The iliacus ;
3. The psoas, with a bursa beneath it ;
4. The anterior crural nerve.

In the *inner compartment* the following structures are situated from without inwards :

1. The crural branch of the genito-crural nerve (fig. 71) ;
2. The femoral artery ;
3. The femoral vein ;
4. The crural canal, through which a femoral hernia descends.

5. The femoral sheath (see fig. 80) ;

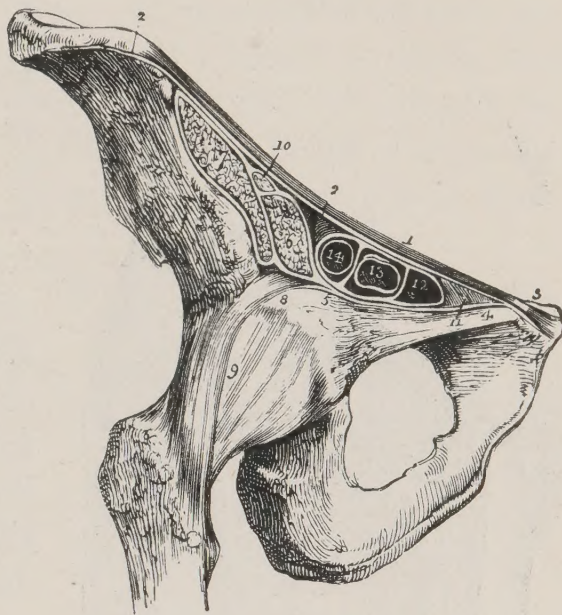
6. The origin of the pectineus muscle.

The dissectors of the abdomen will show the attachments and relationships of *Poupart's ligament*. Some of the fibres

of Poupart's ligament, instead of passing to the pubic spine, pass to the ilio-pectineal line (fig. 79) and form a small triangular fibrous shelf, to which the name of Gimbernat's ligament is given. The apex of the ligament lies at the pubic spine ; its sharp base forms the inner margin of the crural passage (fig. 79).

The Femoral Sheath (fig. 80).—The sheath of the femoral vessels is a tubular prolongation of the fasciæ of the abdominal

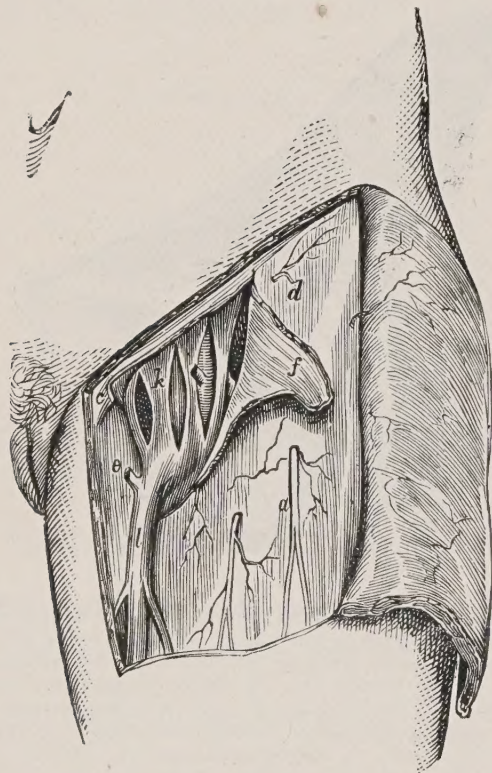
FIG. 79.—THE STRUCTURES WITHIN THE CRURAL PASSAGE. (Wilson.)



1. Poupart's ligament. 2, 2. Iliac portion of the fascia lata, attached along the margin of the crest of the ilium, and along Poupart's ligament, as far as the spine of the pubes (3). 4. Pubic portion of the fascia lata, continuous at 3 with the iliac portion, and passing outwards behind the sheath of the femoral vessels to its outer border at 5, where it divides into two layers ; one is continuous with the sheath of the psoas (6), and iliacus (7) ; the other (8) is lost upon the capsule of the hip-joint (9). 10. The anterior crural nerve. 11. Gimbernat's ligament. 12. The crural ring. 13. Femoral vein. 14. Femoral artery ; the two vessels and the ring are surrounded by the femoral sheath, and thin septa are sent between the anterior and posterior wall of the sheath, dividing the artery from the vein, and the vein from the crural canal.

cavity into the thigh, under the inner half of Poupart's ligament. The anterior layer of the sheath is directly continuous with the fascia transversalis of the anterior abdominal wall, and the posterior layer with the fascia iliaca in the iliac fossa (fig. 80). These two layers form a funnel-shaped sheath, which becomes lost on the proper sheath of the femoral vessels about two inches below Poupart's ligament.

FIG. 80.—FEMORAL SHEATH LAID OPEN.
(Wood.)



a. Middle cutaneous nerve. *c.* Placed to inner side of Gimbernat's ligament. *d.* Iliac portion of fascia lata. *e.* Pubic portion of fascia lata. *f.* Margin of saphenous opening (turned back). *k.* Femoral sheath opened by three incisions. *l.* Saphenous vein.

The sheath is subdivided by two delicate antero-posterior fibrous septa into three compartments (fig. 79). The outer one contains the femoral artery, the middle one the femoral vein, and the internal compartment contains some lymph-vessels as they pass upwards from the saphenous opening to enter the abdomen beneath Poupart's ligament. This inner compartment or *crural canal* is the least definite of the three, but is surgically important, as through it a femoral hernia descends to reach the saphenous opening.

The Crural Canal (figs. 78, 79).—The upper end of the crural canal, situate under Poupart's ligament, receives the name of the *crural or femoral ring*. Into it the tip of the little finger should be introduced, and it will be seen that

it forms the aperture of the communication between the abdominal cavity and thigh. It is bounded *in front* by Poupart's ligament, *internally* by the base of Gimbernat's ligament, *externally* by the fibrous septum lying between the canal and the femoral vein, and *posteriorly* by the pectineus and the fascia which covers it.

The term *deep crural arch* is applied to some transverse fibres, continuous with the falciform margin of the saphenous opening, which pass over the upper part of the femoral sheath,

beneath Poupart's ligament. Lying in the crural ring will be found some lymphatic vessels and a small quantity of the sub-peritoneal tissue and fat. In it a small lymphatic gland may be imbedded. This tissue constitutes the *septum crurale* and forms one of the coverings of a femoral hernia, being pushed in front of the bowel when it descends through the crural ring towards the saphenous opening.

Femoral Hernia.—As we have already mentioned, a femoral hernia leaves the abdomen through the *femoral ring* and descends through the *crural canal* to reach the surface by passing through the saphenous opening, whence it bends upwards and outwards over Poupart's ligament. It should be noted that the *neck* of a femoral hernia lies below Poupart's ligament, while the neck of an inguinal hernia lies above that structure.

From the course taken by a femoral hernia it will be seen to receive the following coverings :

1. The hernial sac derived from the parietal peritoneum ;
2. The sub-peritoneal tissue or *septum crurale* as it passes through the crural ring ;
3. The femoral sheath forming the crural canal ;
4. The cribriform fascia as the hernia passes through the saphenous opening ;
5. The skin and superficial fascia.

These various layers are compressed together when a hernia descends and cannot be distinguished individually.

Femoral hernia is more common in the female than in the male. Owing to the greater capacity of the female pelvis and the more vertical position of the ilium, the crural passage and crural canal are larger in the female than in the male. The male is the more liable to inguinal hernia owing to the great weakening of the abdominal wall by the passage of the testicle and spermatic cord.

DISSECTION V

SCARPA'S TRIANGLE

Scarpa's Triangle (Plate XXII).—When the great artery for the lower limb emerges beneath Poupart's ligament it passes through a well-marked triangular space in the upper third of the

PLATE XXII.

THE CONTENTS OF SCARPA'S TRIANGLE

Muscles.

- A. Sartorius.
- B. Iliacus.
- C. Pectineus.
- D. Adductor longus.
- E. Adductor brevis.
- F. Tensor vaginae femoris.
- G. Vastus externus.
- H. Rectus femoris.

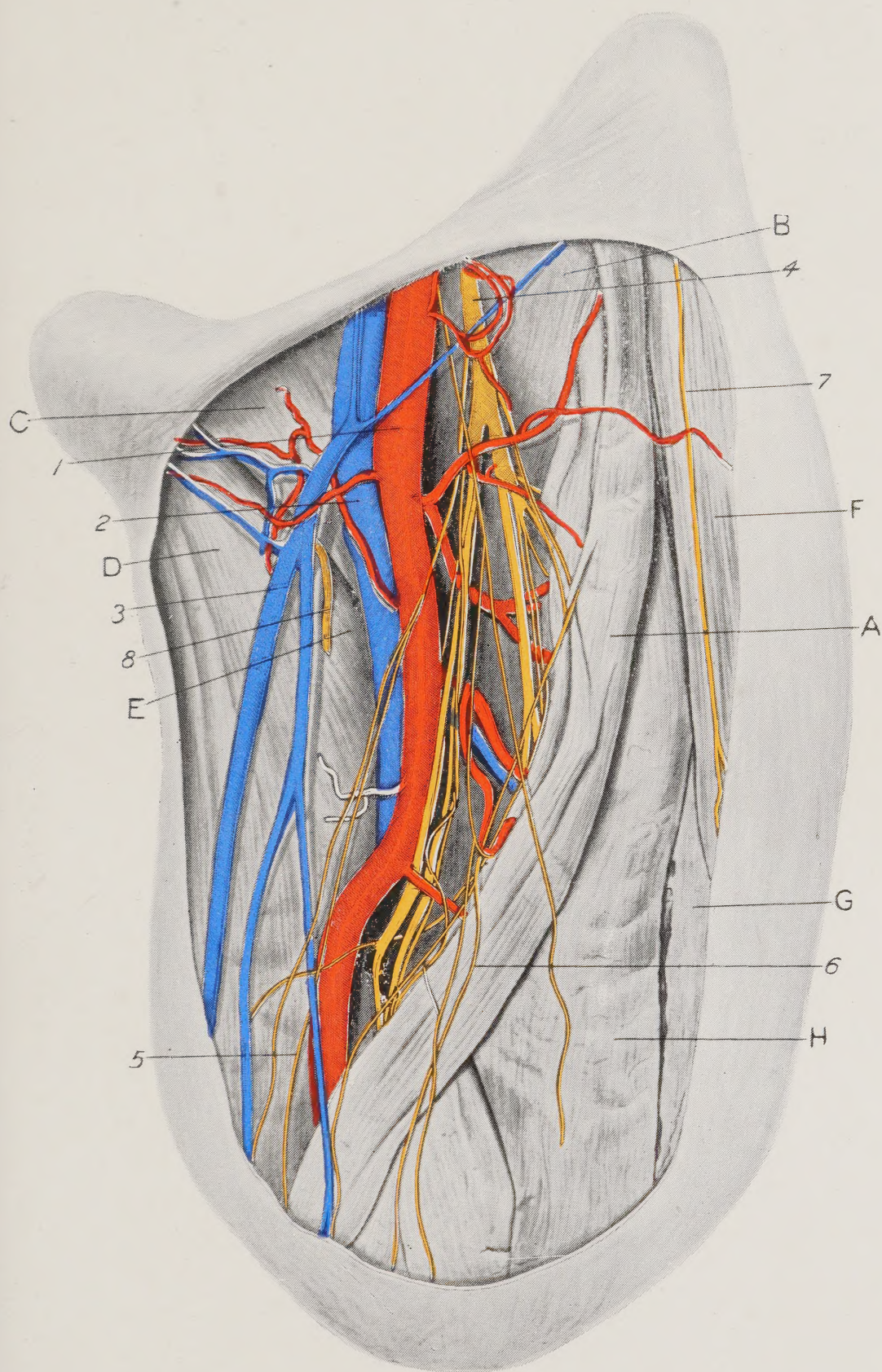
Vessels.

- 1. Common femoral artery.
- 2. Common femoral vein.
- 3. Long saphenous vein.

Nerves.

- 4. Anterior crural.
- 5. Internal cutaneous.
- 6. Middle cutaneous.
- 7. External cutaneous.
- 8. Superficial division of obturator.

PLATE XXII.



thigh. It is this triangular space—Scarpa's triangle—which the dissector is now to study. Within this space the surgeon may have to secure the artery. In order to examine its boundaries, the deep fascia must be removed from the upper third of the thigh. The structures which bound the triangle are to be defined and cleaned.

BOUNDARIES.—The sides of the triangle are formed by the sartorius *externally* (figs. 78 and 81), by the prominent border of the adductor longus *internally*. The *apex* is formed at the point of junction of these two muscles. The *base* is formed by Poupart's ligament.

The *floor* (fig. 81)—to be examined more minutely at a later stage—is formed from without inwards by (1) the iliacus, (2) psoas, (3) pectineus, and (4) the adductor longus. (5) A small portion of the adductor brevis sometimes appears between the adductor longus and pectineus.

A section across the triangle is shown in fig. 82.

CONTENTS.—These should be carefully cleaned and traced one by one; some of them have been already partially seen (Plate XXII).

(1) At the outer angle, close to the anterior spine of the ilium, a small piece of the *external cutaneous nerve* (fig. 77).

(2) Internal to this, lying between the psoas and iliacus, the *anterior crural nerve* and its subdivisions (fig. 77).

(3) Internal to the crural nerve lie the *femoral vessels*, enclosed in the *femoral sheath*, the vein being internal to the artery (fig. 82).

(4) From the artery are given off its *superficial inguinal branches*.

(5) The *deep femoral artery* arises on the outer side of the

FIG. 81.—MUSCLES OF THE ANTERIOR FEMORAL REGION. (Wilson.)



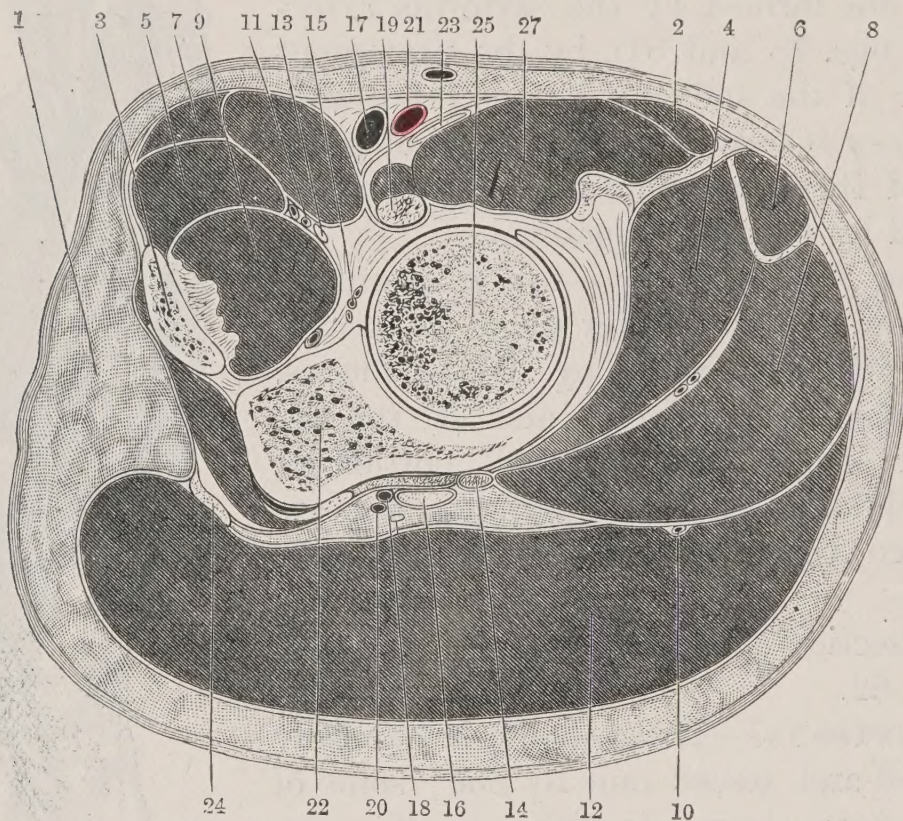
1. Crest of the ilium. 2. Its anterior superior spinous process. 3. Gluteus medius. 4. Tensor vaginae femoris; its insertion into the fascia lata is shown inferiorly. 5. Sartorius. 6. Rectus. 7. Vastus externus. 8. Vastus internus. 9. Patella. 10. Iliacus internus. 11. Psoas magnus. 12. Pectineus. 13. Adductor longus. 14. Part of the adductor magnus. 15. Gracilis.

common femoral, usually about $1\frac{1}{2}$ inches below Poupart's ligament (fig. 83).

(6) The genito-crural nerve pierces the outer part of the sheath.

(7) In those cases in which the adductor brevis appears in the floor of the space between the pectineus and adductor

FIG. 82.—HORIZONTAL SECTION OF THE THIGH AT THE LEVEL OF THE HIP-JOINT, SHOWING THE ROOF, FLOOR, AND CONTENTS OF SCARPA'S TRIANGLE. (*After Braune.*)



1. Fat. 2. Sartorius. 3. Ischial ramus. 4. Gluteus minimus. 5. Adductor brevis. 6. Tensor vaginae femoris. 7. Adductor longus. 8. Gluteus medius. 9. Obturator externus. 10. Artery to gluteus. 11. Pectineus. 12. Gluteus maximus. 13. Obturator. 14. Piriformis tendon. 15. Articular vessels. 16. Great sciatic nerve. 17. Femoral vein. 18, 20. Sciatic vessels. 19. Psoas. 21. Femoral artery. 22. Ischium with obturator internus winding around it. 23. Anterior crural nerve. 24. Great sacro-sciatic ligament. 25. Head of femur. 27. Iliacus (tendon of rectus between it and acetabulum).

longus, a small piece of the superficial division of the obturator nerve may be seen in the triangle lying on the adductor brevis (fig. 77).

THE ROOF.—The roof of the triangle has been already removed. It was formed by: (1) The fascia lata (fig. 82). The saphenous opening allows the internal saphenous vein to pierce the roof and enter the triangle. The cribriform fascia closes the saphenous opening. (2) Over the fascia lata rests the superficial fascia containing the superficial glands and struc-

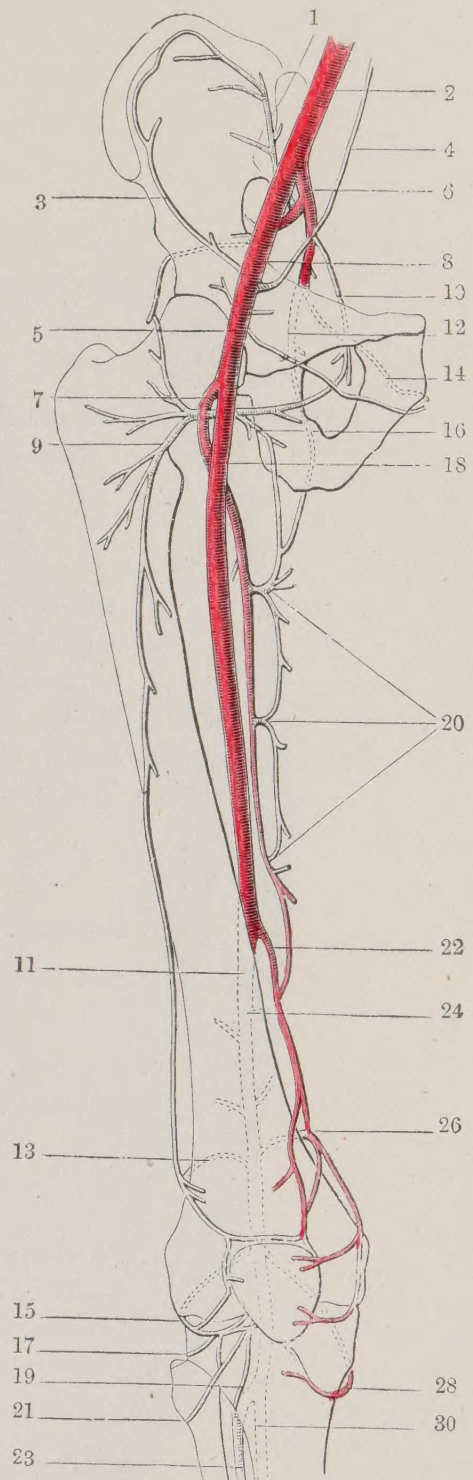
tures already enumerated. (3) The skin.

Femoral Artery.—The femoral artery, a continuation of the external iliac, commences beneath Poupart's ligament at a point half an inch internal to the mid-point of that structure (fig. 70). It extends obliquely downwards and inwards to the opening in the adductor magnus, where it enters the popliteal space and becomes the popliteal artery (fig. 83).

The course of the artery may be indicated by drawing a line from the above-mentioned point of origin to the adductor tubercle on the femur, the limb being slightly flexed and abducted. The artery is quite superficial as it lies in Scarpa's triangle, and can be readily compressed in this region against the head of the femur or ramus of the pubes. Beyond the limits of Scarpa's triangle, the artery dips underneath the sartorius muscle and lies in Hunter's canal (Plate XXIII).

Femoral Artery in Scarpa's Triangle. — RELATIONS (Plate XXII). *Superficial* to the artery are the skin, fasciæ (superficial and deep), some superficial inguinal glands, and the crural

FIG. 83.—DIAGRAM OF THE FEMORAL ARTERY AND ITS BRANCHES. (Anderson.)



1. Ilio-lumbar artery. 2. Common iliac artery. 3. Deep circumflex iliac, anastomosing with ilio-lumbar of internal iliac. 4. Deep epigastric. 5. Common femoral. 6. Internal iliac, dividing into anterior and posterior trunks. 7. Deep femoral (profunda). (Should be larger at origin.) 8. External iliac. 9. Descending branch of external circumflex. 10. Obturator. 11. Popliteal. 12. Sciatic. 13. Superior external articular, anastomosing with external circumflex, &c. 14. Internal pudic. 15. Inferior external articular. 16. Lower terminal branch of internal circumflex. 17. Posterior tibial recurrent (from anterior tibial). 18. Superficial femoral (muscular branches omitted). 19. Anterior tibial recurrent. 20. Perforating branches of deep femoral, forming anastomotic loops and supplying posterior muscles. 21. Superior fibular. 22. Anastomotica magna. 23. Anterior tibial. 24. Popliteal, giving off superior muscular branches. 26. Superior internal articular. 28. Inferior internal articular (sural arteries arising below this omitted). 30. Posterior tibial.

PLATE XXIII.

SARTORIUS DISPLACED TO SHOW THE CONTENTS OF
HUNTER'S CANAL.

Muscles.

- A. Adductor longus.
- B. Adductor magnus.
- C. Sartorius.
- D. Vastus internus.
- E. Rectus femoris.
- F. Vastus externus.

Artery.

- 1. Femoral.

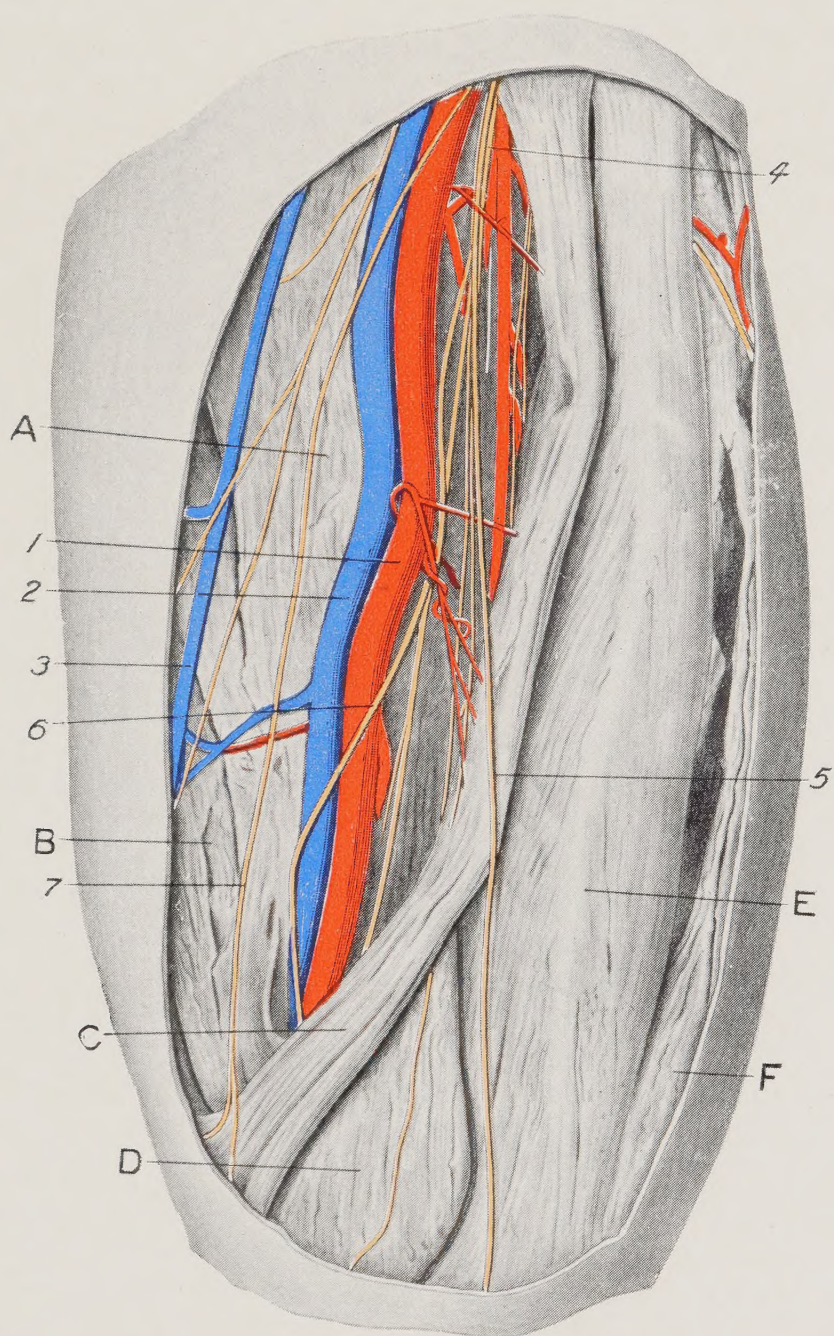
Veins.

- 2. Femoral.
- 3. Internal saphenous.

Nerves.

- 4. To vastus internus.
- 5. Anterior branch of internal cutaneous.
- 6. Internal saphenous.
- 7. Posterior branch of internal cutaneous.

PLATE XXIII.



branch of the genito-crural nerve. Near the apex of the triangle the internal cutaneous nerve crosses obliquely inwards over the artery.

Beneath the artery will be found the psoas, pectineus, and adductor longus muscles (fig. 81). The deep femoral artery, the femoral vein and deep femoral vein also lie under the artery in a part of its course. The small nerve to the pectineus crosses obliquely behind the artery near Poupart's ligament (fig. 77).

To the *outer side* of the artery is the anterior crural nerve. The nerve breaks up into numerous branches, the nerve to the vastus internus and long saphenous being close to the artery (fig. 77).

On the *inner side* of the artery is situated the femoral vein in the upper part of the triangle, but the vein passes behind the artery near the apex of the triangle.

DISSECTION VI

HUNTER'S CANAL

Having thus examined the boundaries of Scarpa's triangle, and followed the femoral artery through it, the dissector should now turn to the course of the artery in the middle third of the thigh. Here it lies in a well-marked fibro-muscular canal (fig. 84), named after Hunter because he was the first to show that the artery may be secured here in the treatment of popliteal aneurism.

The **Sartorius** helps to form the roof of the canal (fig. 84), and should therefore be examined now. It should be cleaned from origin to insertion.

ORIGIN.—From the anterior superior spine and anterior border of the ilium just below the spine (fig. 81).

INSERTION.—To the inner aspect of the shaft of the tibia, over the insertions of the semi-tendinosus and gracilis, and by a short fascial expansion to the capsule of the knee and to the fascia of the leg (Plate XXI).

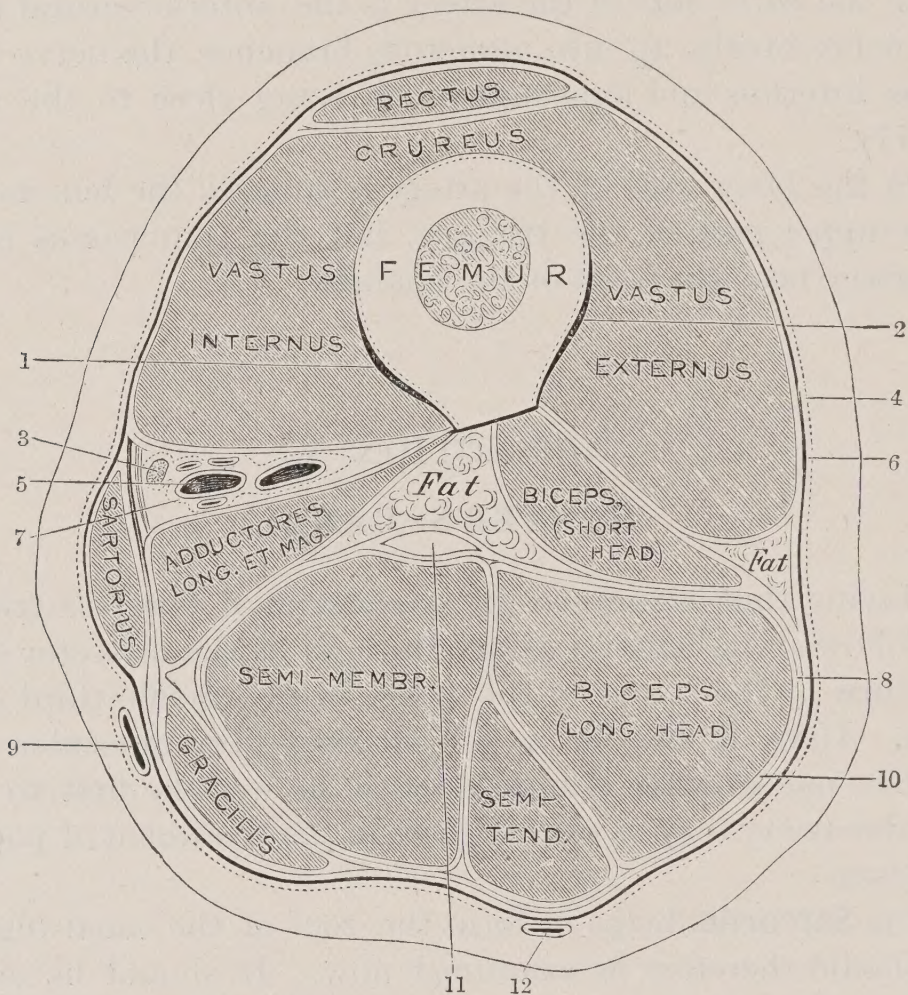
In the upper third of the thigh, the muscle forms the outer boundary of Scarpa's triangle; in the middle third it helps to form the roof of Hunter's canal; in the lower third it lies on

the inner boundary of the popliteal space and inner aspect of the knee-joint.

NERVE SUPPLY.—From the superficial division of the anterior crural nerve.

ACTION.—It flexes both the hip and knee joints, an action well seen in the position assumed by tailors: hence its name. It also adducts the thigh.

FIG. 84.—SECTION OF THE THIGH, SHOWING THE FORMATION OF HUNTER'S CANAL, AND THE POSITION OF THE INTERMUSCULAR SEPTA. (*Anderson.*)



- 1, 2. Lymph spaces. 3. Long saphenous nerve. 4. Superficial fascia. 5. Femoral artery, with small venæ comites (femoral vein deeper). 6. Deep fascia continued over back of thigh as superficial layer of deep fascia. 7. Sheath of vessels. 8. Middle layer of deep fascia. 9. Long saphenous vein. 10. Deep layer of deep fascia (muscular aponeurosis). 11. Great sciatic nerve. 12. Vein.

Hunter's canal should now be opened by lifting the sartorius from its bed opposite the middle third of the thigh. A membranous layer of fascia will be exposed, extending from the adductors to the vastus internus (fig. 84). Underneath this the contents of the canal, viz. the femoral vessels and long saphenous nerve, can be displayed by means of a longitudinal

incision. When the muscle is lifted up, twigs from the long saphenous, obturator, internal and middle cutaneous nerves should be looked for. They form the sub-sartorial plexus.

Hunter's Canal extends from the apex of Scarpa's triangle to the opening for the femoral artery in the adductor magnus and lies in the middle third of the thigh. It is bounded *superficially* by the sartorius and the aponeurotic expansion beneath it which extends from the adductors to the vastus internus; *externally* by the vastus internus; and *behind and internally* by the adductors longus and magnus (fig. 84).

The fibrous expansion which roofs over the space will be found to become thicker as it is traced downwards, and to terminate abruptly in a free border, beneath which the long saphenous nerve and a branch of the anastomotic artery appear (fig. 77).

CONTENTS (Plate XXIII).—The canal contains (1) the femoral artery, (2) the femoral vein, and (3) the long saphenous nerve. The nerve is superficial to the artery, and crosses over it from its outer to its inner side. (4) In the upper part of the canal, the nerve to the vastus internus (fig. 77).

The vein lies beneath the artery and inclines slightly inwards in the upper part of the space. Lying against the outer wall of the space is the nerve to the vastus internus (fig. 77). Some deep lymphatic vessels accompany the femoral vein, the blood-vessels and lymphatics being enclosed in a delicate fibrous sheath. The contents and boundaries require careful cleaning to display them well.

Femoral Artery in Hunter's Canal (Plate XXIII and fig. 77).

RELATIONS.—*Superficially*, in addition to the integument and fasciæ, will be found the sartorius muscle and the aponeurotic layer forming the roof of the canal. The long saphenous nerve crosses obliquely inwards over the artery.

Beneath are the adductors longus and magnus and the femoral vein—the vein being slightly external to the artery at the lower part of the canal, but becoming internal to it at the apex of Scarpa's triangle. On the *outer side* of the artery is the vastus internus and its nerve.

DISSECTION VII

BRANCHES OF THE FEMORAL ARTERY

Having followed the course of the main artery, the dissector must now turn to an investigation of the branches which arise from it. They are numerous and require much labour to display them properly. He will find the dissection rendered much easier by dissecting away the veins which accompany the branches of the femoral artery. The sartorius muscle should be detached from its origin and thrown downwards.

One point should be noted now. That part of the femoral artery which lies above the origin of the deep femoral is known as the *common femoral*; the part beyond the origin of the *deep femoral* is designated the *superficial femoral* (fig. 83).

(a) In *Scarpa's triangle* the following branches arise :

1. Superficial epigastric ;
2. Superficial circumflex iliac ;
3. Superficial external pudic. The above branches have been already described (p. 156).
4. Deep external pudic. This branch passes inwards over the pectineus and beneath the deep fascia to supply the skin of the scrotum in the male and the labia in the female. It anastomoses with branches of the internal pudic and cremasteric arteries.

5. The DEEP FEMORAL artery (*profunda femoris*) (fig. 85).

(b) In *Hunter's canal* the following branches come off :

6. Muscular branches ;
7. *Anastomotica magna* (fig. 83).

The **Anastomotica Magna** (fig. 83) is given off from the anterior surface of the femoral artery near its termination at the lower end of Hunter's canal. It divides almost immediately into a superficial and a deep branch. The *superficial* branch accompanies the long saphenous nerve beneath the sartorius, and ends in superficial branches on the inner side of the knee and upper part of the leg. The *deep* branch passes down towards the inner side of the knee in front of the tendon of the adductor magnus, lying partly in the substance of the vastus internus. It is frequently of considerable size, and is liable to

be wounded in the operation for knock-knee. It joins the general arterial plexus around the knee (peri-articular plexus), anastomosing more especially with the superior internal articular branch of the popliteal (fig. 83).

Before the deep femoral artery and its branches can be displayed satisfactorily, it is necessary to examine and reflect three muscles. These are the Tensor vaginæ femoris; the Rectus femoris, which is part of the Extensor quadriceps femoris, the great extensor muscle of the knee; and the Adductor longus.

Tensor Vaginæ (Fasciæ) Femoris (fig. 81).—**ORIGIN.** From the anterior part of the outer lip of the iliac crest, from the anterior border of the ilium for a short distance, and from the fascia over the gluteus medius (Plate XVI).

INSERTION.—By the ilio-tibial band to the outer tuberosity of the tibia and head of the fibula. The insertion is received between the deep and superficial layers of the ilio-tibial band (p. 173).

NERVE SUPPLY.—The superior gluteal nerve ends in the muscle. The muscle is really one of the gluteal group. It covers the anterior borders of the gluteus medius and minimus.

ACTION.—It abducts the thigh; it may also act as a rotator inwards. In walking it helps to balance the body on the lower extremity. The muscle should now be cut away at its origin and reflected downwards.

Rectus Femoris.—**ORIGIN.** By two tendinous heads (Plate XVI). The *reflected* tendon will be found arching backwards to be inserted above the acetabulum. The *straight* head arises from the anterior inferior iliac spine. The origin is tendinous and is prolonged into the muscle. The fibres arise from it in a bipinnate manner and pass to the tendon of insertion.

INSERTION.—The tendon of insertion passes to the upper border of the patella. Fibres join it from the vastus externus and internus (fig. 81).

NERVE SUPPLY.—By a branch from the deep division of the anterior crural nerve.

ACTION.—It flexes the hip-joint and extends the knee.

The muscle is to be detached at its origin and thrown downwards. The external circumflex artery and nerves from the anterior crural will be found passing outwards beneath it.

The origin of the muscle is seen to rest on the capsule of the hip-joint.

Adductor Longus (figs. 81 and 86).—**ORIGIN.** By a rounded tendon from the angle of the pubes between the pubic crest and symphysis. The tendon of origin can be distinctly felt when the muscle is in action.

INSERTION.—To the inner border of the linea aspera (Plate XVII).

NERVE SUPPLY.—From the superficial division of the obturator nerve.

ACTION.—It adducts and rotates the thigh outwards.

The prominence of the muscle forms the inner boundary of Scarpa's triangle. Its insertion lies between the deep and superficial femoral arteries (fig. 85). The muscle is to be removed, only its insertion being left.

The Deep Femoral Artery or Profunda Femoris.—**COURSE.** This vessel, which supplies the greater part of the thigh, is given off from the outer and back part of the femoral artery about $1\frac{1}{2}$ inches below Poupart's ligament (figs. 83 and 85). It passes downwards and inwards behind the femoral vessels and adductor longus to terminate (as the fourth perforating artery) by piercing the adductor magnus a short distance above the opening in that muscle for the femoral artery. It is separated from the femoral artery by the femoral and profunda veins and the adductor longus. It lies successively on the iliacus, psoas, pectineus, adductor brevis and adductor magnus.

BRANCHES OF PROFUNDA ARTERY.—The profunda artery gives off (1) the internal and (2) external circumflex arteries (fig. 83), (3) muscular branches, and (4) three perforating arteries. The terminal branch is sometimes named the fourth perforating. One or both circumflex arteries may arise directly from the common femoral. This is frequently the case with the external circumflex.

(1) The **Internal Circumflex Artery** comes off from the inner and back part of the profunda near its commencement. It passes backwards successively between (a) the pectineus and psoas, (b) adductor brevis and obturator externus (fig. 86), (c) adductor magnus and quadratus femoris, terminating, as has been already seen, in the lower part of the buttock by joining the external circumflex, sciatic and first perforating arteries, in the so-called *crucial anastomosis* (fig. 67, p. 152).

In its course it gives off branches which pass *upwards* to supply the obturator externus and hip-joint and anastomose

with the obturator artery, and others which pass *downwards* to supply the adductor muscles. Before it appears at the back of the thigh it gives off an ascending branch which follows the tendon of the obturator externus to the digital fossa and there supplies the back of the hip and anastomoses with the sciatic and gluteal arteries.

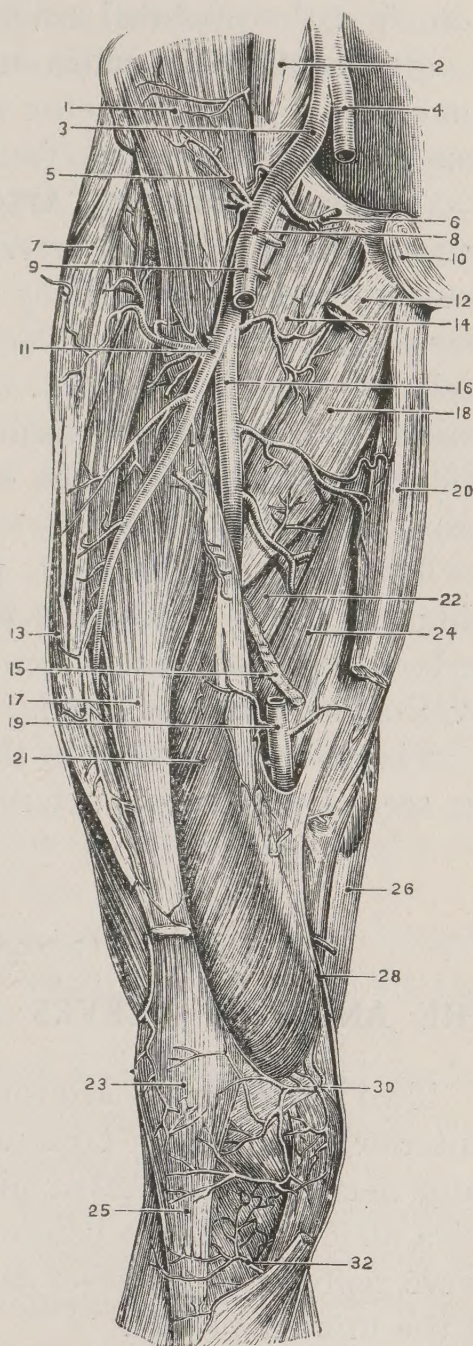
(2) The **External Circumflex Artery** (Plate XXII) passes outwards beneath the sartorius and rectus femoris, and between the branches of the anterior crural nerve. It divides into ascending, transverse, and descending branches (fig. 85).

(a) The *ascending branch* pierces the deep layer of the ilio-tibial band and, passing beneath the tensor fasciæ femoris, supplies the adjacent muscles and anastomoses with the gluteal artery (fig. 83).

(b) The *transverse branch* pierces the vastus externus and winds round the femur below the great trochanter to join with the internal circumflex, first perforating, and sciatic arteries in the *crucial anastomosis* (fig. 83).

(c) The *descending branch* passes down under the anterior edge of the vastus externus, accompanied by the nerve to that muscle. It supplies the vastus externus and crureus

FIG. 85.—THE PROFUNDA FEMORIS AND ITS BRANCHES. (*Bonamy and Beau.*)



1. Iliacus. 2. Psoas. 3. External iliac artery.
4. Internal iliac artery. 5. Deep circumflex iliac. 6. Deep epigastric. 7. Tensor vaginæ femoris. 8. Common femoral artery. 9. Superficial femoral artery. 10. Symphysis pubis. 11. External circumflex artery. 12. Adductor longus (origin).
13. Vastus externus. 14. Pectineus. 15. Adductor longus (insertion). 16. Profunda (too large in the drawing). 17. Crureus. 18. Adductor brevis. 19. Femoral in Hunter's canal. 20. Gracilis. 21. Vastus internus. 22. Part of adductor magnus.
23. Patella. 24. Part of adductor magnus. 25. Ligamentum patellæ. 26. Semimembranosus. 28. Anastomotica magna. 30. Superior internal articular. 32. Inferior internal articular.

muscles, its terminal branch reaching as far as the knee, where it anastomoses with the superior external articular branch of the popliteal artery (fig. 83).

(3) **Muscular branches** supply the adductor group of muscles, some piercing the adductor muscles, on a plane internal to the true perforating arteries, to terminate in the hamstrings.

(4) The **Perforating Arteries** are given off from the deep surface of the profunda artery and pierce the adductor muscles close to the femur. They are frequently irregular in their disposition, and they also vary in number. Having reached the back of the thigh (fig. 67, p. 152) they cross over the linea aspera, close to the bone, and terminate in the vastus externus. As they cross the back of the femur they supply branches to the hamstring muscles.

The *first* and *second* perforating branches pierce the adductor brevis and adductor magnus; the *third* and *fourth* perforating branches pierce the adductor magnus below the level of the adductor brevis.

The *nutrient artery* to the femur is usually given off from the second perforating artery.

DISSECTION VIII

THE ANTERIOR NERVES AND MUSCLES OF THE THIGH

Two nerve trunks are found in the front of the thigh—the Anterior Crural and Obturator. Both are derived from the same nerves of the lumbar plexus (fig. 71), and both have a long intra-abdominal stage before they reach the thigh. The crural nerve represents *posterior* and the obturator *anterior* divisions of the lumbar plexus.

Anterior Crural Nerve.—This is the largest branch of the lumbar plexus, derived from the second, third, and fourth lumbar nerves, and appears in Scarpa's triangle about a third of an inch external to the femoral artery. It lies at first in a groove between the psoas and iliacus muscles, and divides almost immediately into two divisions, superficial and deep, from which numerous muscular and cutaneous branches are given off (fig. 77). Within the abdomen, branches are given off to the iliacus and pectineus. The nerve to the pectineus

reaches that muscle by passing obliquely behind the femoral artery (fig. 77).

The *superficial* division supplies branches to (1) the sartorius and (2) the two middle and (3) the internal cutaneous nerves (see p. 171).

The *deep* division supplies branches to (1) rectus femoris, (2) crureus, (3) vastus internus, (4) vastus externus, and (5) one cutaneous branch, viz. the long saphenous. The nerve to the rectus supplies a twig to the hip-joint. The nerves to the crureus and vasti give off long branches which reach the knee-joint. From one of the nerves to the crureus, a long slender twig passes down to the sub-crureus. This small nerve lies on the femur close to the anterior edge of the vastus internus. The *long saphenous* nerve has been described (see p. 171).

Before proceeding to examine the obturator nerve two muscles need to be examined and removed. They are the Pectineus and Gracilis (fig. 85).

Pectineus.—ORIGIN. From the triangular surface of the pubes in front of the ilio-pectineal line; from the fascia over it and Gimbernat's ligament.

INSERTION.—To the femur behind the small trochanter to a line passing to the linea aspera (Plate XVII).

NERVE SUPPLY.—By a twig from the anterior crural, occasionally by another from the superficial division of the obturator nerve.

ACTION.—The fibres are directed downwards, backwards, and outwards. The muscle acts mainly as a rotator out of the thigh. It also adducts and flexes the thigh.

The muscle lies in the floor of Scarpa's triangle; its origin lies beneath Poupert's ligament. Beneath the muscle will be found the obturator externus, the adductor brevis, the obturator nerve and vessels (fig. 77).

The muscle is to be detached and cut away.

Gracilis.—ORIGIN. From the inner margin of the ascending ramus of the ischium and descending ramus of the pubes. Its origin is wide, thin and fibrous (Plate XVI).

INSERTION.—By a long tendon to the inner aspect of the tibia, below the internal tuberosity. Its insertion lies beneath that of the sartorius (Plate XXI).

A bursa lies beneath its insertion, separating it from the internal lateral ligament.

NERVE SUPPLY.—From the superficial division of the obturator.

ACTION.—The chief action is to assist in balancing the body on the lower extremity. It can adduct the thigh, flex the leg and rotate it inwards. The muscle should be detached at its origin and thrown down.

Obturator Nerve.—This nerve is given off from the second, third, and fourth nerves of the lumbar plexus (fig. 71). Having traversed the outer wall of the pelvic cavity, it enters the thigh by passing with the obturator artery through the obturator canal in the upper part of the obturator foramen.

In the foramen it divides into two main divisions, superficial and deep (fig. 77).

The *superficial division* passes down above the obturator externus, and over the adductor brevis and under the adductor longus. It supplies branches to (1) the hip-joint, (2) adductor longus, (3) gracilis, and occasionally to (4) the pectineus and (5) adductor brevis. (6) One branch appears below the lower border of the adductor longus, and unites beneath the sartorius with twigs of the long saphenous and internal cutaneous nerves to form the *sub-sartorial plexus*, from which *cutaneous* twigs are derived (Plate XXIII). (7) A terminal branch reaches the femoral artery and ramifies on its walls.

Adductor Brevis (fig. 86).—To see the deep division of the obturator nerve and obturator artery, it is necessary to examine this muscle and remove it. The deep branch of the obturator will be seen piercing the obturator externus and passing beneath the upper border of the muscle. The nerve guides the dissector to the deep limits of the adductor brevis, for frequently it is difficult to separate from the adductor magnus, which lies behind it.

ORIGIN.—From the rami of the pubis and ischium, between the origins of the obturator externus and gracilis and below the origin of the adductor longus (Plate XVI).

INSERTION.—Behind the pectineus to the line between the lesser trochanter and linea aspera (Plate XVII).

NERVE SUPPLY.—From the deep division of the obturator nerve.

ACTION.—It adducts the thigh and may rotate it outwards. It assists in balancing the body on the lower extremity.

The *deep division* of the obturator nerve pierces the obturator

externus and then passes down *beneath* the adductor brevis on the surface of the adductor magnus. It supplies branches to (1) the obturator externus, (2) adductor brevis, (3) the adductor magnus, and (4) knee-joint. The *geniculate articular* branch passes down on the surface of the adductor magnus to reach the popliteal space by piercing that muscle just above the opening for the femoral artery (fig. 68, p. 155). In the popliteal space it passes on the popliteal artery and divides into twigs which pierce the posterior ligament of the knee.

An *accessory obturator* nerve may be present. It is composed of some fibres of the nerve which pass *over* instead of *under* the horizontal ramus of the pubis. It supplies fibres to the hip-joint and again joins the main nerve.

Obturator Artery.—The obturator artery, with an accompanying vein, will be found escaping with the nerve from the pelvis by the obturator canal. The artery arises either from the anterior division of the internal iliac and passes forwards on the outer wall of the pelvis (fig. 65), or from the deep epigastric artery. If its origin is from the latter, it will be found to pass downwards in close relationship to the crural ring, through which a femoral hernia descends.

When the artery has emerged by the obturator canal, it divides into an inner and outer branch, which lie partly buried in the obturator externus muscle. The *outer branch* is the larger; it supplies the hip-joint, and ends beneath the obturator externus, on the outer side of the obturator foramen. The *inner branch* descends on the rami of the pubes and ischium, on the inner border of the obturator foramen. Branches pass to the adductor muscles; some anastomose with branches from the internal circumflex. The outer and inner branches form an arterial circle round the obturator foramen.

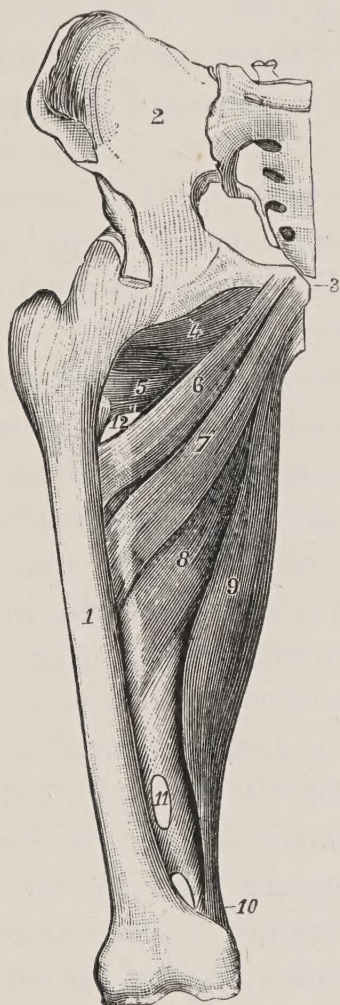
The *obturator* vein accompanies the artery and passes to the internal iliac vein, or frequently to the external iliac.

Obturator Hernia.—A piece of bowel or omentum may descend in the obturator canal, forming an obturator hernia. Such a hernia is situated behind the pectineus muscle and cannot be felt distinctly from the groin.

Adductor Magnus (fig. 86).—The posterior aspect of this muscle was seen in the dissection of the back of the thigh (fig. 67, p. 152); its anterior aspect has been exposed by the

removal of the adductors longus and brevis, and now, in order that the muscle may be cleaned, the femoral artery and its branches, with the anterior crural and obturator nerves, should be completely removed.

FIG. 86.—THE ADDUCTOR MUSCLES OF THE THIGH. (Wilson.)



Femur. 2. Ilium. 3. Pubes. 4. Obturator externus. 5. Upper portion of adductor magnus. 6. Upper portion of adductor brevis. 7. Lower part of the same muscle. 8. Middle portion of adductor magnus, partly covered by adductor brevis. 9. Lower part of adductor magnus, terminating in a round tendon (10). 11. Opening for femoral artery. 12. Opening for the passage of the internal circumflex vessels.

ORIGIN.—From the ischio-pubic rami and the lower external part of the ischial tuberosity (Plate XVI). The origin is very extensive. The gracilis covers the pubic part of its origin.

INSERTION.—The upper or pubic fibres pass transversely outwards to be inserted to the femur along an impression on the inner side of the gluteal ridge; the lower or ischial fibres pass downwards and are inserted by a sharply marked tendon to the adductor tubercle and the internal supra-condylar ridge of the femur (Plate XXI); the intermediate fibres are inserted to the inner lip of the linea aspera (Plate XVII). The insertion of the intermediate fibres is interrupted by a series of tendinous arches through which the perforating arteries appear on the back of the thigh (fig. 67, p. 152).

NERVE SUPPLY.—The muscle is mainly supplied from the deep division of the obturator nerve; the ischial fibres receive a branch from the great sciatic.

ACTION.—It is a most powerful adductor of the thigh; it rotates the thigh outwards; the ischial fibres extend the thigh.

The muscle forms a great internal septum between the flexor and extensor aspects of the thigh. It is a muscle

which requires close examination to obtain a clear conception of its many anterior and posterior relationships.

When studied the adductor magnus should be completely cut away.

Quadriceps Extensor Cruris (fig. 81).—It is composed of four parts :

- (1) The rectus femoris, which has already been examined (p. 187) ;
- (2) The vastus externus ;
- (3) The vastus internus ;
- (4) The crureus and sub-crureus.

The three parts named last are partly fused together, and form a great muscular sheath on the femur ; the linea aspera is the only part of the shaft of the femur that is left uncovered by their origin (Plate XXIV).

Vastus Externus.—The external circumflex vessels pass under the inner border of this part of the quadriceps, and guide the dissector to the inner limits of the muscle (fig. 85). A glance at a section will show how this part overlies the crureus or middle part of the quadriceps (fig. 84).

ORIGIN.—By a fibro-muscular origin from (*a*) the upper half of the anterior inter-trochanteric line, (*b*) from the base of the great trochanter (Plate XVII), (*c*) from the external inter-muscular septum and upper half of the linea aspera and from the gluteal ridge.

INSERTION.—The fibres pass downwards and inwards to end on a flat aponeurosis on the deep surface of the muscle. By this aponeurosis it is inserted (*a*) to the upper border of the patella, (*b*) to the tendon of the rectus above the patella, (*c*) to the outer side of the patella ; (*d*) a fibrous expansion of the muscle blends with the deep fascia and helps to form the capsule of the knee-joint.

This part of the quadriceps should be raised from its attachment to the femur and removed, all but its insertion to the patella.

Vastus Internus.—It is only for a short distance above the patella that the vastus internus can be distinctly separated from the crureus. In the upper part of the thigh they are inseparable.

ORIGIN.—From (*a*) the lower half of the anterior inter-trochanteric line, (*b*) the inner lip of the linea aspera, (*c*) the insertions of the adductors longus and magnus.

INSERTION.—The fibres pass to an aponeurosis on the deep surface of the muscle. Through this they are attached to the upper border and inner side of the patella, some fibres joining

the tendon of the rectus. The lower part of the muscle gradually becomes fibrous and blends with the deep fascia to help in the formation of the capsule of the knee-joint.

Crureus.—ORIGIN. From the upper two-thirds of the shaft of the femur on its anterior and outer aspects, and from the lower half of the external intermuscular septum.

INSERTION.—The short fibres end on an aponeurotic expansion placed on their superficial aspect. Through this they are inserted to the upper border of the patella.

Sub-crureus.—The crureus and vastus internus should be raised from the femur, from above downwards. The lower fibres of the crureus, arising from the shaft of the femur a little above the patella, will be found semi-detached and inserted to the upper fornix of the synovial membrane of the joint. To this bundle the name of sub-crureus is given. It acts on the synovial membrane, keeping it from being ‘nipped’ between the femur and patella in extension of the joint.

NERVE SUPPLY.—Each of the four parts of the quadriceps receives a separate nerve from the anterior crural. The nerve to the vastus internus lies in the upper part of Hunter’s canal.

ACTION.—It is the great extensor of the knee-joint. Its typical action is seen on rising from a kneeling posture. The rectus femoris also flexes the hip-joint. The lower fibres of the vasti retain the patella in position.

Patella and Ligamentum Patellæ.—The tendinous insertions of the four parts of the quadriceps are blended together at the patella and form the *common tendon of insertion*. But the real tendon of the quadriceps is the ligamentum patellæ, a short and strong tendon passing from the patella to the lower part of the anterior tuberosity of the tibia (fig. 99, p. 238). The patella or knee-cap is a sesamoid bone developed in the tendon of insertion of the quadriceps.

The ligamentum patellæ should be cleaned and defined now. It is imbedded in and forms part of the capsule of the knee-joint in front (fig. 99). Between it and the lateral ligaments of the joint the capsule is comparatively thin, and is composed of two layers closely blended together. One layer will be found to be continuous with the fascia lata, the deeper with the vastus externus and internus muscles.

Lateral Patellar Ligaments.—The patella, like the ligamentum patellæ, is also imbedded in the capsule of the

PLATE XXIV.

THE POINTS OF MUSCULAR ATTACHMENT ON THE EXTENSOR
ASPECT OF THE FEMUR. (*After Holden.*)



knee-joint. Those parts of the capsule which bind the patella to the lateral condyles of the femur and retain it in position are known as the *lateral patellar* ligaments.

Sub-crureal Bursa.—Under the crureus muscle and above the capsule of the knee-joint will be found a large bursa, extending upwards for a couple of inches above the patella. In the majority of bodies this bursa is in free communication with the cavity of the knee-joint, and may appear to be part of it (see fig. 98, p. 236).

The crureus and vastus internus should be cut away a short distance above the patella.

Sub-patellar Bursa.—When the capsule is separated from the lateral borders of the ligamentum patellæ it will be found to rest on the sub-patellar pad of fat which separates the tendon from the cavity of the joint (fig. 98). Below the pad of fat, and between the upper and smooth part of the anterior tubercle of the tibia and the ligamentum patellæ, will be found the sub-patellar bursa. It should be opened and examined.

The patella and its articulation with the trochlea of the femur, the lateral patellar ligaments, the ligamentum patellæ, the sub-crureal and sub-patellar bursæ must be regarded as intrinsic parts of the quadriceps extensor cruris. They are adjuncts of its tendon of insertion.

Violent action of the quadriceps, as in attempting to prevent a fall, may snap the patella in two, across the trochlear surface of the femur. In such a case only the skin and subcutaneous tissue save the cavity of the joint from being exposed.

Ilio-psoas.—**ORIGIN.** The origin of this composite muscle lies within the abdomen (fig. 87). The dissectors of the abdomen will point out the origin of the *psoas* from the bodies of the lumbar vertebræ and their transverse processes and the *iliacus* from the upper and outer two-thirds of iliac fossa and the base of the sacrum (Plate XVI). The iliac fascia forms the anterior part of their sheath.

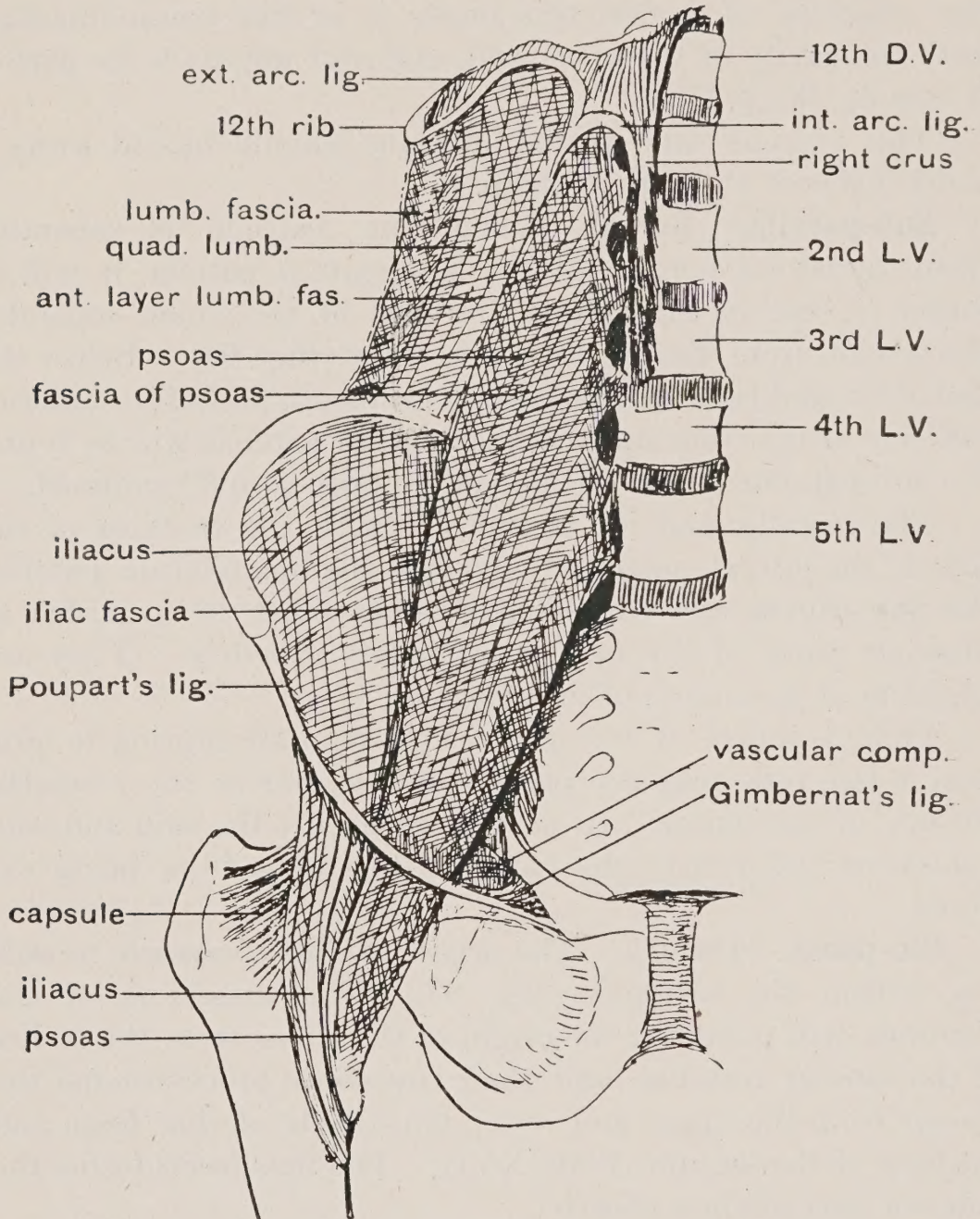
INSERTION.—The *psoas* becomes tendinous as it leaves the abdomen beneath Poupart's ligament; the tendon is inserted to the small trochanter. The fibres of the *iliacus* muscle converge and join the tendon of the *psoas*, but the outer are inserted directly to the femur just below the small trochanter.

NERVE SUPPLY.—The *psoas* is supplied from the lumbar

plexus (2nd and 3rd lumbar nerves), the iliacus from the anterior crural nerve (2nd and 3rd lumbar nerves).

ACTION.—The ilio-psoas is the most powerful flexor of the hip-joint; it may act from either the body or thigh. From its

FIG. 87.—THE ILIO-PSOAS MUSCLE AND ITS FASCIA.



insertion to the small trochanter, which is situated on the inner side of the femur, it also acts as a rotator out of the thigh.

Sub-psoas Bursa.—The insertion of the ilio-psoas is to be detached and the muscle turned upwards. It rests on the

capsule of the hip-joint and horizontal ramus of the pubis. As it is turned upwards a well-marked bursa (sub-psoas) will be seen to lie beneath the psoas tendon. It allows the tendon to ply in front of the pubis and capsule of the joint without friction. The bursa may communicate with the cavity of the hip-joint, through a foramen in the capsule.

The dissector will see how a spinal abscess, formed at the origin of the psoas muscle, may make its way down the sheath in the substance of the muscle and point in the groin in front of the hip-joint. Through the bursa, the pus may find its way into the cavity of the joint. He will also observe how the femoral artery, which rests on the psoas muscle, may be pressed forwards on such an abscess. The kidney and cæcum rest on the muscle. Hence these organs are slightly pressed on as the muscle thickens during contraction.

Obturator Externus (fig. 86).—In order to study the rather complicated relationships of this muscle, the femur must be cut through so as to leave the upper third attached to the pelvis. The muscle is then to be cleaned and studied. The obturator artery ramifies in it.

ORIGIN.—From the outer surface of the obturator membrane in its anterior half, and from the adjacent margin of bone (Plate XVI).

INSERTION.—By a rounded tendon to the digital fossa of the femur (Plate XVII).

NERVE SUPPLY.—From the obturator nerve.

ACTION.—The main direction of the muscle is outwards. Its typical action is seen on crossing one leg over the other. It flexes the hip-joint and rotates outwards the femur; it adjusts the articular surfaces of the femur and acetabulum.

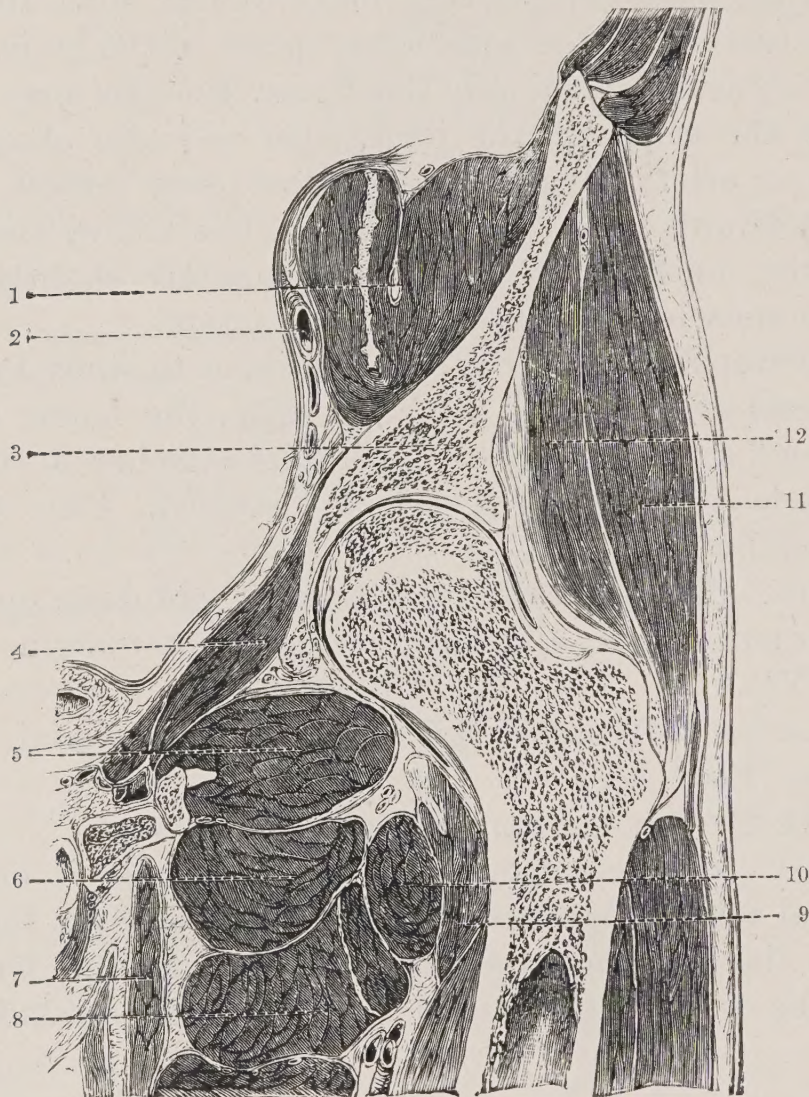
DISSECTION IX

THE HIP-JOINT

The hip-joint is one of the strongest in the body; the spherical head of the femur fits within the deep cup of the acetabulum; yet dislocation is not uncommon. The long lower extremity forms a powerful lever on which accidental forces may act so as to thrust the head from its socket,

and extrude it from the stout capsule of the joint. A little investigation will serve to show that the weakest point of the capsule is on the posterior and internal aspects of the joint; it is this part which gives way in traumatic dislocations. The anterior part is very rarely ruptured. An intimate knowledge

FIG. 88.—VERTICAL SECTION SHOWING THE CAPSULE AND RELATIONS OF THE HIP-JOINT. (*Braune.*)



1. Anterior crural nerve in substance of iliacus internus. 2. External iliac artery. 3. Ilium.
 4. Obturator internus. 5. Adductor magnus. 6. Obturator externus. 7. Adductor longus.
 8. Adductor brevis. 9. Ilio-psoas. 10. Pectineus. 11. Gluteus medius. 12. Gluteus minimus.

of the joint and its surroundings is necessary for the successful reduction of dislocations.

In examining the hip-joint, the following points have to be noted: (1) The muscles which surround it; (2) the capsule and movements of the joint; (3) the lining of synovial membrane; (4) the round ligament; (5) the acetabulum; (6) the head of the femur.

(1) **Muscles around the Hip-joint** (figs. 82 and 88) :

In front.—Pectineus, ilio-psoas, and rectus femoris.

Behind.—Pyriformis, obturator internus and gemelli, quadratus femoris and obturator externus.

Above.—The gluteus minimus.

Below.—The obturator externus, adductor brevis, and pectineus.

(2) **Capsule of the Hip-joint** (figs. 89 and 90).—When the capsule of the hip-joint is cleaned, it is seen to be a tubular sheet of fibrous tissue attached to the os innominatum above and femur below. Above, it is attached to the circumference of the acetabulum, and the transverse ligament which bridges the acetabular notch. The strong rope-like anterior part of the capsule (ilio-femoral part) springs from the anterior inferior iliac spine.

Below, the capsule is attached to the anterior inter-trochanteric or spiral line in front; behind, the capsule is weakly attached to the neck of the femur less than half an inch above the posterior inter-trochanteric line (fig. 90).

It will thus be seen that the head, and practically the entire neck, lie within the capsule of the hip-joint, and that any fracture of the neck must be intra-capsular.

Ilio-femoral Ligament (fig. 89).—The strong specialised anterior part of the capsule, which is attached to the anterior inferior iliac spine, is known as the ilio femoral ligament. It is composed of two sets of fibres—vertical and transverse. The vertical fibres pass to the lower part of the spiral line; the transverse pass to a tubercle on the anterior border of the great trochanter.

The *vertical fibres* of the ilio-femoral ligament prevent over-extension of the joint. On standing at attention, the body is bent backwards on the hip-joint until the resistance of this ligament comes fully into play; it then supports the weight of the body. The *transverse fibres* limit outward rotation and adduction of the thigh. The ilio-femoral ligament is very rarely ruptured in dislocation.

FIG. 89.—THE ILIO-FEMORAL OR Y-SHAPED LIGAMENT. (Bryant.)



Pubo-femoral Ligament.—A prominent bundle of capsular fibres from the pubis receives this name. With the rest of the capsule on the inner aspect of the joint, it limits the abduction of the femur; this is also limited by the neck coming in contact with the upper edge of the acetabulum. When abducted the head comes to rest on the inner and lower part of the capsule.

Ischio-capsular Ligament.—A bundle of the capsular fibres on the posterior aspect of the joint is so named; the fibres arise from the ischium below the acetabulum and pass

upwards in a spiral manner. The fibres on the posterior aspect of the joint are transverse when the joint is flexed; spiral when the joint is extended.

(3) **Synovial Membrane.**—Before the anterior part of the capsule is cut away to expose the interior of the joint, with its lining of synovial membrane, the student should pull on the femur

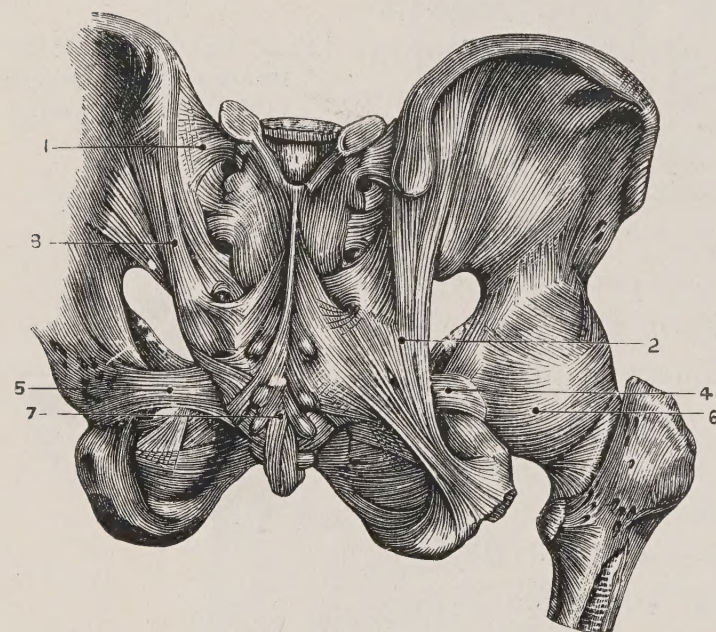


FIG. 90.—THE HIP AND PELVIC LIGAMENTS.
(Bonamy and Beau.)

1. Posterior sacro-iliac ligament. 2. Great sacro-sciatic ligament.
3. Oblique sacro-iliac ligament. 4. Lesser sacro-sciatic ligament.
5. The same, exposed by the removal of the greater. 6. Back part of capsule of hip-joint. 7. Posterior sacro-coccygeal ligament.

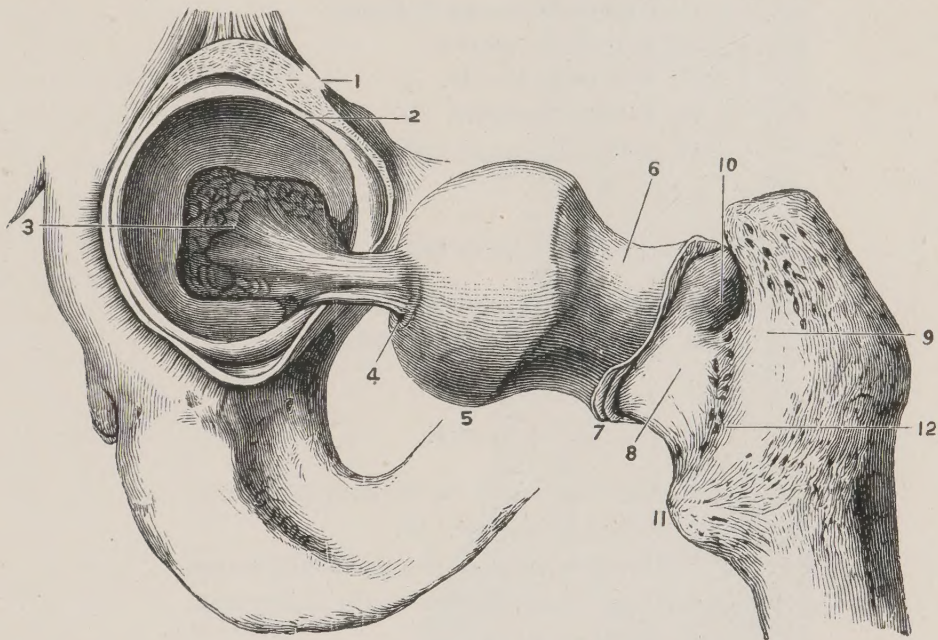
so as to withdraw the head partially from its socket. The capsule is lax enough to allow this to be done. So accurately does the ball fit the socket that a vacuum is produced within the joint; the atmospheric pressure has to be overcome before the head starts from its cavity. Thus the pressure of the atmosphere helps to keep the femoral head in position.

When the anterior part of the capsule is removed the synovial membrane can be examined. It lines the capsule throughout. At the insertion of the capsule below, the synovial membrane is reflected on the neck of the femur, which it covers right up to the edge of the articular cartilage (fig. 88).

It covers the upper two-thirds of the neck of the femur behind (fig. 91). Above, the synovial membrane is reflected from the capsule to the cotyloid ligament, which it covers on both aspects. It also ensheaths the round ligament and covers the fat of the acetabular fossa. The membrane presents a smooth surface and secretes a substance which lubricates the joint.

Reflected Capsular Band (fig. 88).—The synovial membrane on the lower aspect of the neck will be seen to be raised by a band of fibres reflected to the head of the femur from the insertion of the capsule. These form the reflected

FIG. 91.—SHOWING THE ROUND LIGAMENT OF THE HIP-JOINT, COTYLOID LIGAMENT, AND REFLECTION OF SYNOVIAL MEMBRANE ON THE NECK OF THE FEMUR. (*Sappey.*)



1. Ilio-femoral band of capsular ligament, cut across. 2. Cotyloid ligament. 3. Ligamentum teres. 4. Insertion of ligamentum teres into the head of the femur. 5. Head of the femur. 6. Neck of the femur. 7. Attachment of capsular ligament to the back of the neck of the femur. 8. Neck of the femur external to attachment of capsular ligament. 9. Great trochanter. 10. Pit on the great trochanter. 11. Small trochanter. 12. Posterior inter-trochanteric line.

capsular band; in fracture of the femoral neck they may remain intact and unite the fragments.

(4) **The Round Ligament.**—The ligamentum teres or round ligament is a cord-like bundle of fibres, ensheathed by synovial membrane, which unites the head of the femur to the acetabular fossa (fig. 91). It is attached to the fossa on the head of the femur and to the transverse ligament and margin of the cotyloid or acetabular notch. It is not a strong ligament; vessels pass by it to the head of the femur. It is rendered tense when the thigh is adducted and flexed.

PLATE XXV.

SUPERFICIAL STRUCTURES ON THE EXTENSOR ASPECT OF THE LEG AND FOOT.

Muscles.

- A. First dorsal interosseus.
- B. Peroneus tertius.
- C. Extensor brevis digitorum.
- D. Extensor longus hallucis.
- E. Peroneus longus.
- F. Peroneus brevis.
- G. Tibialis anticus.
- H. Extensor longus digitorum.

Ligaments.

- I. Inferior anterior annular.
- J. Superior anterior annular.

Nerves.

- 1. Anterior tibial on dorsum of foot.
- 2. External saphenous.
- 3. Outer branch of musculo-cutaneous.
- 4. Inner branch of musculo-cutaneous.
- 5. Anterior tibial.

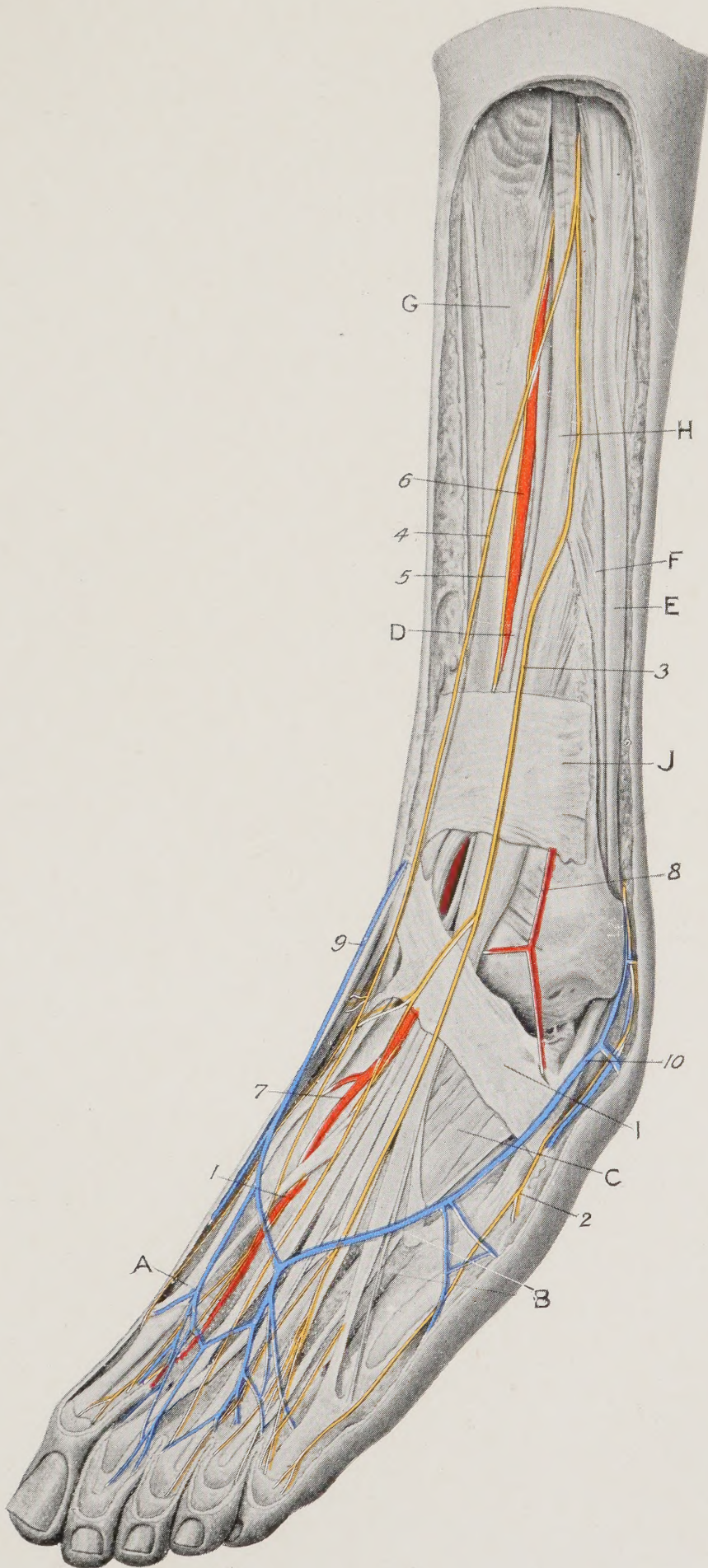
Arteries.

- 6. Anterior tibial.
- 7. Dorsalis pedis.
- 8. Anterior peroneal.

Veins.

- 9. Internal saphenous.
- 10. External saphenous.

PLATE XXV.



(5) **The Acetabulum.**—The *cotyloid ligament* forms a fibro-cartilaginous margin to the cup-like acetabulum; it deepens the cavity. It crosses the cotyloid notch on the *transverse ligament*, beneath which the branches from the obturator vessels and nerves enter the joint. The acetabular fossa contains fat, over which the synovial sheath of the round ligament is reflected. The cartilaginous surface of the acetabulum is crescentic in form, being arranged around the fossa and notch.

(6) **The Head of the Femur.**—The head of the femur forms two-thirds of a sphere; in the upright position, it is completely received within the acetabulum.

DISSECTION X

FRONT OF THE LEG

Surface Markings.—It is impossible for the student to spend too much time over the surface anatomy of the knee and ankle joints. Almost every day he will have to deal with diseased conditions of these joints; the accuracy of his diagnosis will depend largely on the degree with which he is able to recognise the various parts and structures which enter into their formation.

KNEE-JOINT.—He should re-examine the patella and its connections; note again the *ligamentum patellæ*, lateral patellar ligaments (fig. 99, p. 238), and observe the relationship of the patella to the condyles of the femur during a movement from complete extension to complete flexion of the joint, which he can do best on his own knee. On the inner side of the joint he should note the four muscles and tendons arranged thus: from before backwards—the *sartorius*, *gracilis*, *semimembranosus* and *semitendinosus* (Plate XXI); the tuberosity of the internal condyle and the internal tuberosity of the tibia; the circumference of the internal semilunar cartilage; and the internal lateral ligament.

On the outer side of the joint, the external tuberosity of the tibia, with the head of the fibula lying behind it, should

be felt. The tendon of the biceps, external lateral ligament, origin of the popliteus muscle, external popliteal nerve, and tuberosity of the external condyle should be noted (Plate XX).

LEG.—The anterior border or crest of the tibia can be traced down from the tubercle of the tibia. It is sinuous in outline and becomes indistinct below. Next trace the internal border of the tibia from the internal tuberosity to the internal malleolus.

The internal surface of the tibia between these borders is subcutaneous almost throughout its entire extent. The head and lower extremity of the fibula can be felt, the shaft being almost entirely covered by muscles. Compare the two malleoli and notice that the external is narrow, extends further down, and lies on a plane behind the internal malleolus.

Behind the internal malleolus (Plate XXXIII) the tendon of the tibialis posticus may be felt, and behind the external malleolus the tendons of the peronei (longus and brevis) (Plate XXVIII).

In the front of the ankle the tendons of the tibialis anticus and extensors of the toes can be distinguished (Plate XXV).

THE FOOT.—On the inner border of the foot the following parts may be felt (Plate XXXIII) :

- (1) The inner tuberosity of the os calcis.
- (2) The sustentaculum tali, about an inch vertically below the internal malleolus.
- (3) In front of this, and about one and a half inches in front of the malleolus, the prominent tubercle of the scaphoid.
- (4) To this tubercle the tendon of the tibialis posticus may usually be traced from behind the internal malleolus.
- (5) Immediately behind the tubercle of the scaphoid is the inner end of the mid-tarsal joint (the site of Chopart's amputation) (Plate XXXVII).
- (6) In front of the tubercle of the scaphoid, the internal cuneiform and first metatarsal bone; the base of the first metatarsal can generally be distinguished; immediately behind the base is the inner end of the tarso-metatarsal joint (the site of Hey's amputation) (Plate XXXVII).

On the *outer side* of the foot (Plate XXVIII) :

- (1) The subcutaneous outer surface of the os calcis, crossed by the tendons of the peronei (longus and brevis).
- (2) Further forwards, the prominent base of the fifth metatarsal bone.

(3) Immediately behind this is the outer end of the tarso-metatarsal joint.

(4) About midway between the base of the fifth metatarsal and the peroneal tubercle, if the foot is inverted, the sharp anterior edge of the os calcis may be felt. This edge marks the outer end of the mid-tarsal joint.

Superficial Structures in Front of the Leg and on the Dorsum of the Foot.—In the subcutaneous tissue of this region the following structures are to be found and traced (Plate XXV) :

- (1) Venous arch on the dorsum of the foot.
- (2) Internal (long) saphenous vein, commencing at the inner end of the arch.
- (3) External (short) saphenous, commencing at outer end of arch.
- (4) External saphenous nerve.
- (5) Internal saphenous nerve (Plate XXI).
- (6) Musculo-cutaneous nerve.

REFLECTION OF THE SKIN.—A vertical incision is made on the extensor aspect from the knee above to the interval between the first and second toes below. The skin is reflected outwards and inwards so as to expose the anterior and lateral aspects of the leg and foot. The skin is removed from the dorsal surface of the toes. The leg and foot must be firmly bound down to keep the part firm.

(1) The *venous arch*, which lies over the instep, receives numerous digital veins and also several plantar superficial veins through the clefts of the toes. It terminates laterally in the two saphenous veins.

(2) The *internal saphenous vein* passes upwards in front of the internal malleolus and on the internal subcutaneous surface of the tibia as far as the knee, accompanied by the long saphenous nerve. Its course in the thigh has been previously seen (fig. 74, p. 169).

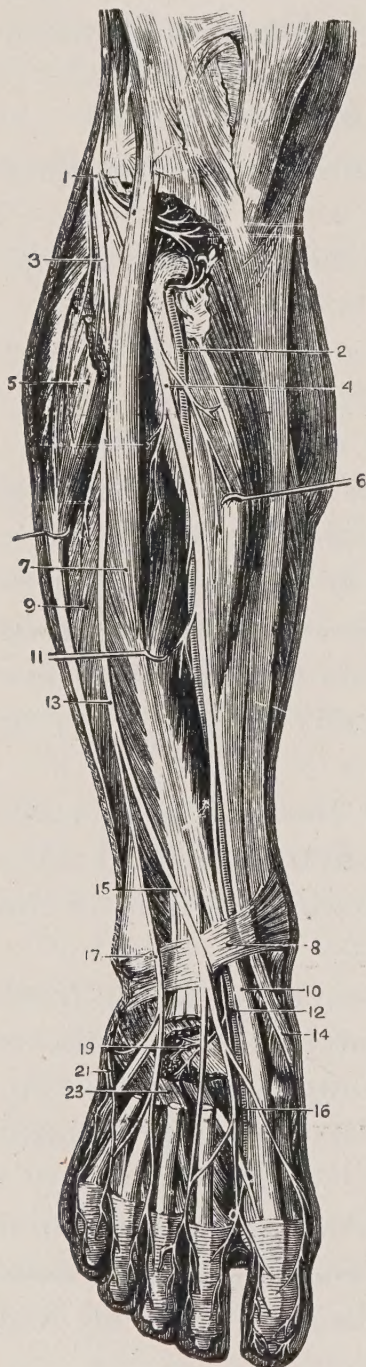
(3) The *short or external saphenous vein* passes up behind the external malleolus in company with the short saphenous nerve. It inclines to the middle of the back of the calf and reaches the popliteal space (Plate XXV).

(4) The *long saphenous nerve* accompanies the vein of the same name on the inner side of the leg and in front of the ankle to the middle of the inner border of the foot. It supplies

the skin of the inner side of the leg and foot as far as the base of the great toe.

(5) The *short saphenous nerve* (figs. 68 and 84) passes with the short saphenous vein behind the external malleolus along the outer border of the foot as far as the outer side of the fifth toe. It frequently unites with a branch of the next nerve and ends also between the fourth and fifth toes.

FIG. 92.—THE DISTRIBUTION OF THE EXTERNAL POPLITEAL NERVE. (*Hirschfeld and Leveillé.*)



(6) The *musculo-cutaneous nerve* is superficial in the lower third of the leg and on the foot (fig. 92). It pierces the deep fascia and divides immediately into two branches, which pass down to the dorsum of the foot over the anterior annular ligament. The *internal* branch supplies twigs to the inner side of the great toe and to the adjacent sides of the second and third toes (Plate XXV). The *external* branch supplies twigs to the adjacent sides of the third, fourth, and fifth toes. The two branches supply cutaneous filaments to the skin of the dorsum of the foot.

The terminal branch of the *anterior tibial nerve* will be found on the dorsum of the foot supplying the adjacent sides of the first and second toes (Plate XXV).

The musculo-cutaneous and anterior tibial nerves are the terminal branches of the external popliteal. The external popliteal has already been traced to the leg (fig. 92).

1. External popliteal nerve. 2. Anterior tibial artery.
3. Musculo-cutaneous nerve. 4. Anterior tibial nerve.
5. Peroneus longus. 6. Tibialis anticus. 7. Extensor longus digitorum. 8. Anterior annular ligament.
9. Peroneus brevis. 10. Tendon of extensor proprius hallucis. 11. Extensor proprius hallucis.
12. Dorsal artery of foot. 13. Point at which musculo-cutaneous nerve pierces the fascia and divides.
14. Tendon of tibialis anticus.
15. Internal branch of musculo-cutaneous nerve. 16. Cutaneous branch of anterior tibial nerve.
17. External branch of musculo-cutaneous nerve. 19. Deep branch of anterior tibial nerve.
21. External saphenous nerve. 23. Extensor brevis digitorum.

hallucis. 11. Extensor proprius hallucis. 12. Dorsal artery of foot. 13. Point at which musculo-cutaneous nerve pierces the fascia and divides. 14. Tendon of tibialis anticus. 15. Internal branch of musculo-cutaneous nerve. 16. Cutaneous branch of anterior tibial nerve. 17. External branch of musculo-cutaneous nerve. 19. Deep branch of anterior tibial nerve. 21. External saphenous nerve. 23. Extensor brevis digitorum.

Communications of Nerves on the Dorsum of the Foot.—

Communications will be found between the branches of the musculo-cutaneous and branches of the anterior tibial, internal saphenous and external saphenous nerves. Very frequently the external saphenous nerve supplies a considerable area of skin normally supplied by the musculo-cutaneous nerve, viz. the fourth and even the third digital interspaces. Cutaneous branches of the *external popliteal nerve* are also distributed partly to the skin of the upper and outer part of the front of the leg (fig. 92).

Deep Fascia.—All the superficial structures just dissected should be cut away and the deep fascia cleaned. It is strong, white and glistening. In the upper part of the leg it is inseparable from the muscles, which arise from its deep surface. Its general arrangement can be seen from the section shown in Plate XXVI.

The deep fascia forms a fibrous sheath for the muscles of the leg, and firm bands, or annular ligaments, which bind down the tendons in the region of the ankle (figs. 92 and 93).

The fascia is attached directly to the anterior and internal borders of the tibia, in its entire length. It is firmly blended with the periosteum of the internal surface of the tibia. Externally it is attached to the extremities of the fibula; to the shaft of that bone it is attached by two intermuscular septa (Plate XXVI) which dip in between the peronei and the anterior and posterior groups of muscles. By means of these intermuscular septa, *three main compartments* are formed (Plate XXVI); the posterior compartment, which lies at the back of the leg, will be studied subsequently.

Annular Ligaments at the Ankle (Plate XXV).—These for the greater part are mere thickenings of the deep fascia in the region of the ankle and bind down the tendons as they pass towards the foot. There are three annular ligaments: anterior, internal, and external.

The *Anterior Annular Ligament* consists of two parts, upper and lower (Plate XXV).

The *upper portion*, named from its shape *ligamentum quadratum*, consists of fibres which pass transversely between tibia and fibula just above the malleoli. As it is simply a thickened part of the deep fascia its borders have to be defined

PLATE XXVI.

A SECTION TO SHOW THE DEEP FASCIA OF THE LEG AND
INTERMUSCULAR SEPTA. (The Fascial Tissue is coloured blue.)

Bones.

1. Tibia.
2. Fibula.

Muscles.

3. Tibialis anticus.
4. Extensor longus digitorum.
5. Extensor longus hallucis.
6. In the interspace between 3 and 4, pointing to the anterior tibial vessels and nerve.
7. Peroneus longus.
8. Pointing to the posterior tibial vessels and nerve.
9. Tibialis posticus.
10. Flexor longus digitorum.
11. Flexor longus hallucis.
12. Soleus.
13. Plantaris.
14. Gastrocnemius.

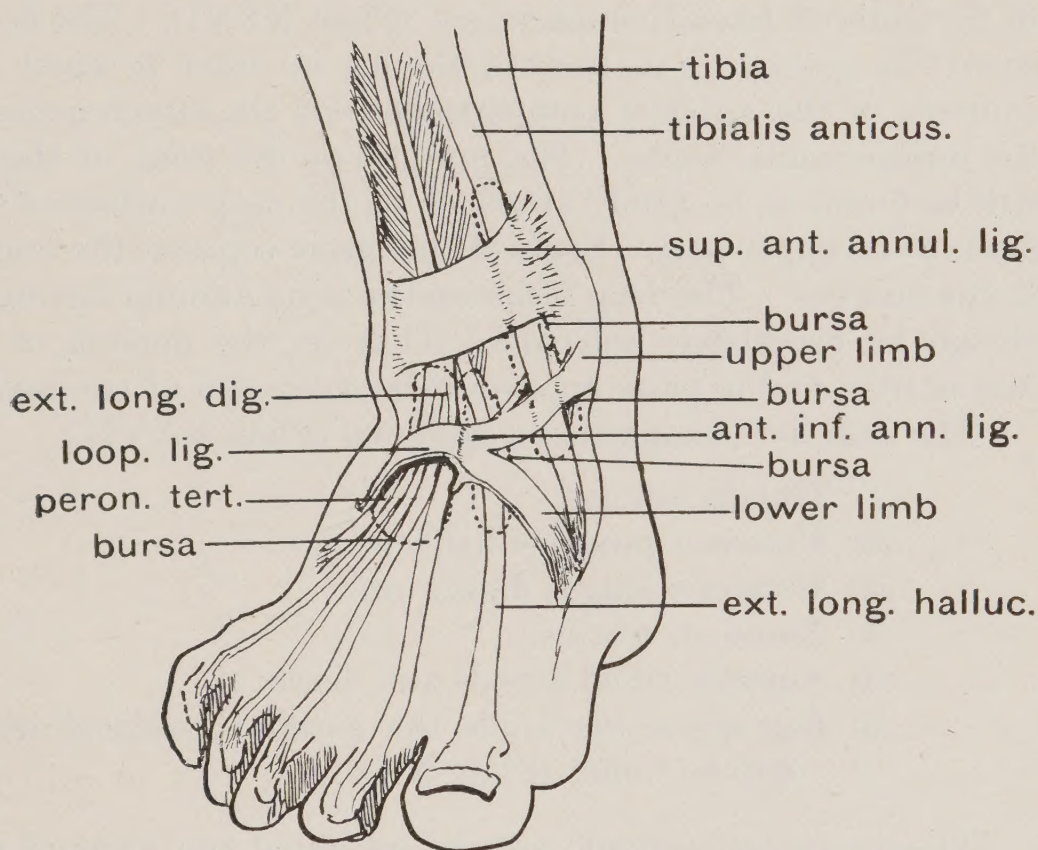
PLATE XXVI



with the knife. Beneath it pass four muscles (Plate XXV); only the tibialis anticus has a synovial sheath here.

The lower portion (*ligamentum cruciatum*) is shaped like a Y placed transversely (fig. 93). The single outer limb of the Y is attached to the anterior upper part of the os calcis in contact with the origin of the extensor brevis digitorum. It forms a loop which encloses the tendons of the extensor longus digitorum and peroneus tertius, the loop being lined by a synovial membrane (fig. 93). The loop (loop ligament) should

FIG. 93.—DIAGRAM OF THE ANTERIOR INFERIOR ANNULAR LIGAMENT.



be defined and raised; it will be seen to form at its origin a structure quite distinct from the deep fascia. At its inner end or convexity the loop ligament blends with the deep fascia, which is thickened, not distinctly as a rule, to form the two inner *limbs* of the Y-shaped ligament.

The *upper limb* is attached to the internal malleolus. The *lower*, dipping downwards and inwards, is attached to the fascia on the inner border of the foot. The tendons of the tibialis anticus and extensor proprius hallucis pass under the two inner limbs and are enclosed each in its own synovial sheath. The

synovial sheath around the tendon of the *tibialis anticus* extends upwards underneath the *ligamentum quadratum*.

In addition to the above-named tendons, the anterior tibial vessels and nerve lie under the anterior annular ligaments, while the musculo-cutaneous nerve passes down superficial to it (Plate XXV).

The internal and external annular ligaments will be studied later. They bind the structures down between the malleoli and the heel (Plate XXV).

Muscles, Vessels and Nerves on the Extensor Aspect of the Leg and Foot (Plate XXV).—In the leg these structures lie in the anterior fascial compartment (Plate XXVI). The fascia should be opened up in front of the leg in order to study the contents of the anterior compartment and the attachments of the intermuscular septa. The muscles on the front of the leg will be found to be firmly attached to the deep surface of the fascia at its upper part. Septa of the fascia separate the origins of the muscles. The deep fascia and anterior annular ligaments should be completely removed. That on the dorsum of the foot is thin, and in parts appears to be composed of two layers.

The anterior compartment contains (Plate XXVI) :

- (1) *Tibialis anticus*.
- (2) *Extensor proprius hallucis*.
- (3) *Extensor longus digitorum*.
- (4) *Peroneus tertius*.
- (5) Anterior tibial vessels and nerve.
- (6) Just above the ankle the anterior peroneal artery will be found (Plate XXV).

These structures should now be separated and cleaned, and their continuations traced on to the dorsum of the foot and toes.

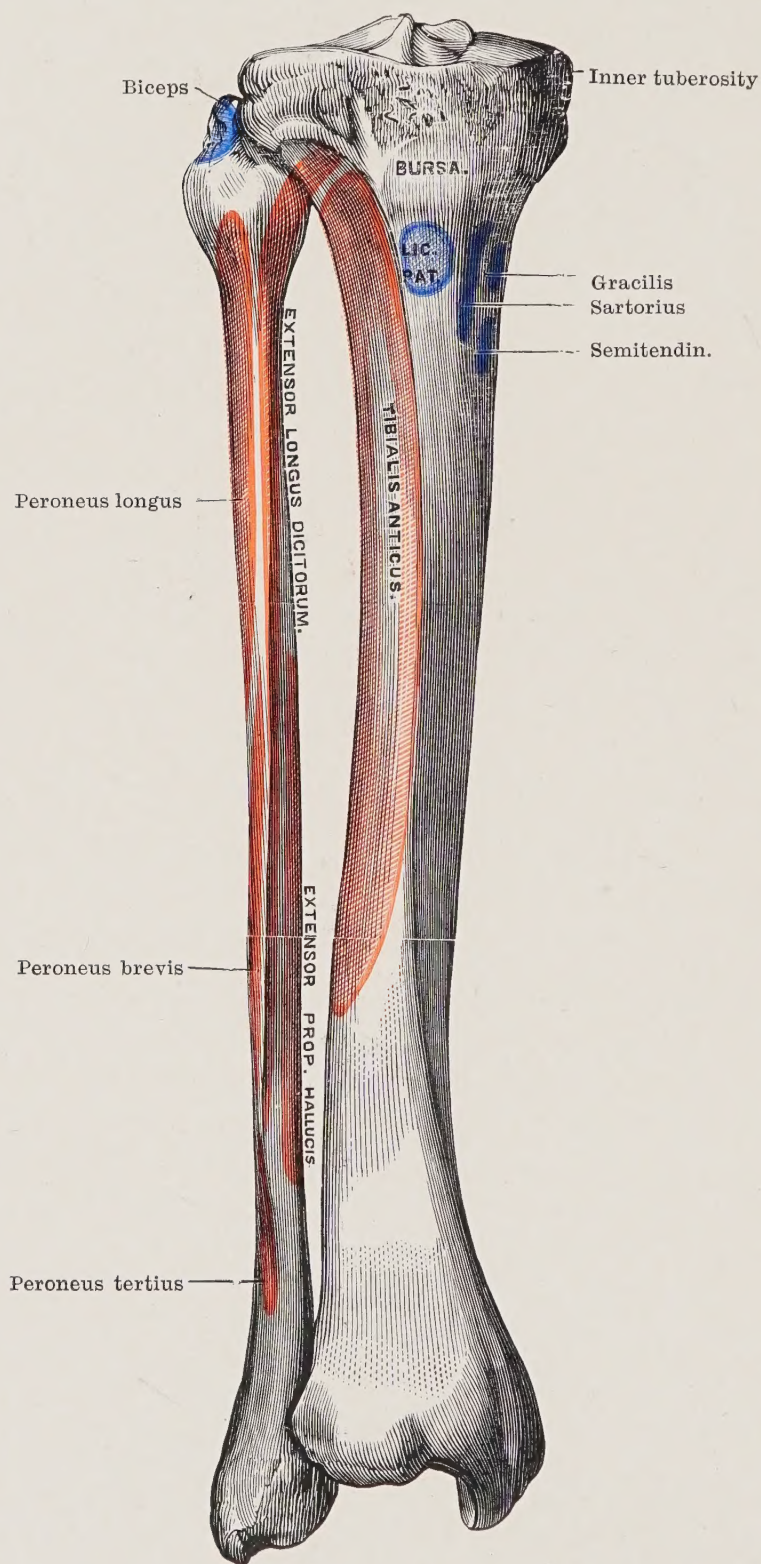
Tibialis Anticus.—**ORIGIN**. From (1) the outer surface of the upper two-thirds of the shaft of the tibia as high as the external tuberosity; (2) from the adjacent part of the interosseous membrane; and (3) from the deep fascia of the leg.

INSERTION.—Into the base of the first metatarsal bone and under surface of the internal cuneiform bone.

The tendon lies within a synovial sheath beneath the anterior annular ligaments. The sheath requires careful examination. In sprains of the ankle-joint the fold or mesentery

PLATE XXVII.

THE POINTS OF MUSCULAR ATTACHMENT ON THE EXTENSOR ASPECT OF THE TIBIA AND FIBULA. (*After Holden.*)



of synovial membrane which binds the tendon to its sheath may be ruptured, or the sheath itself damaged.

NERVE SUPPLY.—From the anterior tibial.

ACTION.—It extends (raises) the foot and at the same time turns the sole inwards (inverts the foot). It is contracted in club-foot and may require to be divided.

Extensor Proprius Hallucis.—**ORIGIN.** From the anterior surface of the fibula (middle third) and adjacent part of the interosseous membrane (Plate XXVII).

INSERTION.—Into the base of the terminal phalanx of the great toe.

The extensor proprius hallucis lies between the extensor longus digitorum and tibialis anticus, and at the ankle it crosses obliquely inwards over the anterior tibial artery (Plate XXV). It is surrounded by a synovial sheath below the anterior inferior annular ligament.

NERVE SUPPLY.—From the anterior tibial nerve.

ACTION.—It extends the great toe and foot.

Extensor Longus Digitorum.—**ORIGIN.** From the anterior surface of the fibula, external tuberosity of tibia and upper part of the interosseous membrane and deep fascia (Plate XXVII).

INSERTION.—In front of the ankle the muscle divides into four tendons, which are inserted to the four outer toes in the same manner as the extensor tendons to the fingers. Over the metatarso-phalangeal joint and first phalanx each tendon forms an expansion which divides in three flattened slips (fig. 48, p. 118). The central slip is inserted into the base of the second phalanx, while the lateral slips unite again to be inserted into the base of the terminal phalanx. The expansions over the proximal phalanges are joined by the tendons of the interossei and lumbrical muscles.

NERVE SUPPLY.—From the anterior tibial.

ACTION.—The muscle extends the toes and foot.

Peroneus Tertius.—The peroneus tertius is really a part of the extensor longus digitorum to the fifth toe which has gained an attachment to the fifth metatarsal bone. Frequently its separation is imperfect (Plate XXV).

ORIGIN.—From the anterior surface of the lower third of the fibula, being continuous here with the origin of the extensor longus digitorum.

INSERTION.—To the dorsal surface of the base of the fifth metatarsal bone.

NERVE SUPPLY.—From the anterior tibial with the nerve to the extensor longus digitorum.

ACTION.—It extends and everts the foot, raising the outer border, so that the sole may be adjusted to the ground.

Extensor Brevis Digitorum Pedis (Plate XXV).—The tendons of the extensor longus digitorum should be cut at the ankle and thrown down.

ORIGIN.—From the anterior part of the upper surface of the os calcis within the *sinus tarsi* and from the loop ligament.

INSERTION.—It ends in four tendons, three of which join the dorsal expansions of the second, third and fourth toes over the metatarso-phalangeal joints. The part to the great toe is almost completely separated (extensor brevis hallucis); its tendon crosses the dorsal artery of the foot and is inserted to the base of the proximal phalanx.

NERVE SUPPLY.—From the external branch of the anterior tibial nerve, which passes under the muscle below the ankle.

ACTION.—It extends and abducts the toes.

Anterior Tibial Artery.—The anterior tibial artery arises from the termination of the popliteal artery at the lower border of the popliteus muscle on the back of the leg (fig. 69, p. 161). A line drawn from a point midway between the tubercle of the tibia and head of the fibula to a point midway between the two malleoli will indicate the position of the artery.

COURSE.—It passes at first directly forwards between the two heads of the tibialis posticus and through the upper parts of the interosseous membrane, thus reaching the front of the leg. It then passes down on the interosseous membrane to the front of the ankle lying in its lower third directly on the tibia (Plate XXV). At the ankle the artery terminates by becoming the dorsalis pedis.

RELATIONSHIPS.—The artery is placed between the muscles in front of the leg; the tibialis anticus being to its inner side, and the extensor longus digitorum in the upper third and extensor proprius hallucis in the lower two-thirds on the outer side. The anterior tibial nerve lies external to the artery near its commencement, and, after lying upon the artery for some distance, becomes external to it again near the ankle. The

tendon of the extensor longus hallucis crosses over the artery near the ankle. Venæ comites accompany the artery.

BRANCHES (fig. 95).—(1) The *posterior tibial recurrent* branch passes upwards beneath the popliteus muscle towards the popliteal space and knee-joint.

(2) The *superior fibular branch* passes upwards over the head of the fibula to the knee-joint. These two branches arise before the artery appears on the anterior aspect of the leg.

(3) The *anterior tibial recurrent* branch passes upwards through the origin of the tibialis anticus to anastomose with the inferior articular arteries. It divides into numerous branches.

These three branches enter into the formation of the peri-articular plexus or arterial anastomoses of the knee. The other arteries entering into the formation of this plexus have been already examined. They are the descending branch of the external circumflex (from deep femoral); the anastomotica magna, deep and superficial branches (from femoral); and the five articular branches of the popliteal artery (fig. 33, p. 181).

(4) The *muscular branches* supply the anterior group of muscles.

(5) The *internal and external malleolar* branches are given off near the ankle and ramify on the malleoli. The malleolar arteries assist in the formation of the periarticular plexus of the ankle.

Dorsalis Pedis Artery (Plate XXV).—A line drawn on the dorsum of the foot, from the mid-malleolar point in front of the ankle-joint to the proximal end of the first interosseous space, indicates the position and course of the artery.

This artery, the continuation of the anterior tibial, passes from the front of the ankle to the posterior part of the first inter-metatarsal space. Here it passes to the sole of the foot to join the termination of the external plantar artery (fig. 107, p. 255). It lies on the astragalus, scaphoid, and two inner cuneiform bones, and between the tendon of the extensor proprius hallucis and the innermost tendon of the extensor longus digitorum. At its termination it is crossed by the innermost tendon of the extensor brevis digitorum. The anterior tibial nerve lies to its outer side. Venæ comites accompany the artery.

BRANCHES.—(1) From its inner side it gives off some branches towards the inner side of the foot (inner plantar).

(2) On its outer side it gives off the *tarsal* branch. (3) Also the *metatarsal* branch (Plate XXV). (4) Before leaving the dorsum of the foot it gives off the *dorsalis hallucis* artery. (5) Having gained the sole of the foot, it supplies the *princeps hallucis* or innermost plantar digital artery (fig. 107).

The *tarsal* artery passes outwards on the tarsus beneath the extensor brevis digitorum and anastomoses with the external malleolar, metatarsal, and peroneal arteries.

The *metatarsal* artery, which frequently arises from the tarsal, passes outwards across the bases of the metatarsal bones. It supplies three dorsal interosseous arteries, which reach the clefts between the four outer toes. There they divide into dorsal collateral branches on the toes. From each interosseous artery two perforating arteries are given off. The *posterior perforating* arteries pass to the sole and join the plantar arch; the *anterior perforating* arteries join the digital branches of the plantar arch.

The *dorsalis hallucis* artery supplies both sides of the great toe and inner side of the second toe on their dorsal aspects, and is connected by a perforating branch with the *arteria princeps hallucis*.

The ANTERIOR PERONEAL ARTERY (Plate XXV) pierces the interosseous membrane and appears between the tibia and fibula just above the ankle. It anastomoses with the external malleolar and tarsal arteries, assisting to form the periarticular plexus of the ankle.

The RECURRENT ARTICULAR BRANCH (fig. 92) of the external popliteal nerve will be found with the anterior tibial recurrent artery. It arises as the external popliteal nerve enters the peroneus muscle on the outer aspect of the neck of the fibula.

Periarticular Plexus of Nerves of the Knee-joint.—The recurrent nerve is the last of the numerous branches which the student has to trace to the knee-joint. He has already seen two articular branches arise from the external popliteal (superior and inferior external articular); three from the internal popliteal (superior and inferior internal, and azygos branches); one from the obturator (geniculate branch); and three from the anterior crural (from the nerves to the vastus externus, internus, and subcrureus). Numerous cutaneous branches end in the skin over the knee—external, middle, and internal cutaneous, long saphenous, and small sciatic nerves.

Anterior Tibial Nerve (fig. 92).—This nerve will be found to arise as one of the terminal branches of the external popliteal nerve, just below the head of the fibula and within the peroneus longus. It should be followed through the extensor longus digitorum, until it reaches the anterior tibial artery. This it accompanies to the ankle. It lies over the artery in the leg, but to the outer side of it at the ankle. At the ankle it divides into two terminal branches, internal and external.

BRANCHES.—(1) In the leg it supplies *muscular* branches to the tibialis anticus, extensor proprius hallucis, extensor longus digitorum, and peroneus tertius.

(2) It also supplies *articular* twigs to the ankle-joint.

(3) The *external* branch supplies the extensor brevis digitorum, and, having become enlarged in a manner similar to the posterior interosseous nerve at the wrist, supplies branches to the joints of the tarsus (fig. 92, 12).

(4) The *internal* branch accompanies the dorsalis pedis artery to the first interspace, where it supplies dorsal digital branches to the adjacent sides of the first and second toes.

The **Musculo-cutaneous Nerve** arises with the anterior tibial as a terminal division of the external popliteal nerve just below the head of the fibula. It should now be traced down, first in the outer compartment, then in relation to the intermuscular septum between the peronei and extensor longus digitorum.

It supplies branches to the peroneus longus and brevis, and becomes cutaneous by piercing the deep fascia near the junction of the middle with the lower third of the leg. Its distribution has already been seen (p. 208, fig. 92).

Contents of the Outer or Peroneal Compartment of the Leg.—When a section of the leg is examined, such as is shown in Plate XXVI, the two peroneal muscles and musculo-cutaneous nerve are seen to be contained in a separate fascial compartment. From the deep surface of the fascia of the leg two septa are given off. One passes inwards between the peroneal muscles and the extensor longus digitorum, to be attached to the antero-external border of the fibula; the other passes in between the peroneal and flexor muscles on the back of the leg to be attached to the postero-external border of the fibula. These septa thus separate a compartment which contains:

- (1) Peroneus longus.
- (2) Peroneus brevis.
- (3) The musculo-cutaneous nerve, already examined.

PLATE XXVIII.

STRUCTURES ON THE EXTERNAL ASPECT OF THE ANKLE-JOINT.

Muscles.

- A. Peroneus tertius.
- B. Extensor brevis digitorum.
- C. Extensor longus digitorum.
- D. Peroneus brevis.
- E. Peroneus longus.
- F. Abductor minimi digiti.

Ligaments.

- G. Plantar fascia.
- H. Superior anterior annular.
- J. Inferior anterior annular.
- K. Position of tendo Achillis.
- L. Middle fasciculus of external lateral of ankle-joint.
- M. Anterior " " " " " " "

Nerves.

- 1. Musculo-cutaneous.
- 2. External saphenous.

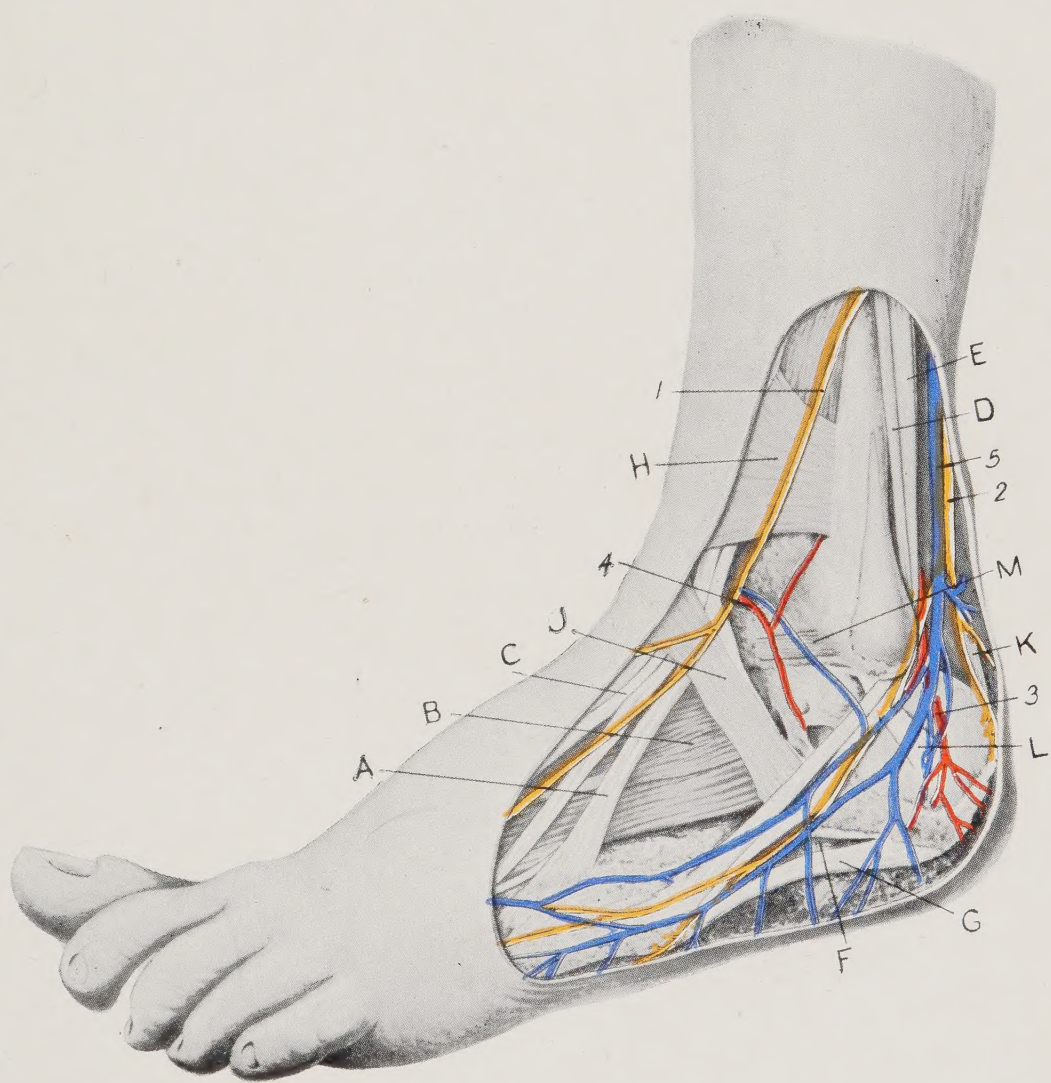
Arteries.

- 3. External calcanean of posterior peroneal.
- 4. Communication between malleolar and anterior peroneal arteries.

Vein.

- 5. External saphenous.

PLATE XXVIII.



Peroneus Longus.—ORIGIN (Plate XXVII). From the upper two-thirds of the outer aspect of the shaft and head of the fibula, from the intermuscular septa and fascia, and slightly from the external tuberosity of the tibia.

INSERTION.—The muscle ends in a tendon which passes in a groove behind the external malleolus. There it is bound down by the external annular ligament, and lies with the tendon of the next muscle in a synovial sheath. It then crosses the outer surface of the os calcis and external lateral ligament of the ankle to reach the groove on the under surface of the cuboid, where a sesamoid may be found in it. It passes, as will be seen in the dissection of the sole, to be inserted into the base of the first metatarsal bone, and slightly into the internal cuneiform bone (Plate XXXVII).

NERVE SUPPLY.—From the musculo-cutaneous.

ACTION.—It abducts, everts, and flexes the foot. In walking it helps to raise the heel.

Peroneus Brevis.—ORIGIN. From the middle two fourths of the shaft of the fibula on its outer surface and from the intermuscular septa.

INSERTION.—Its tendon passes behind the external malleolus, lying between the tendon of the peroneus longus and the bone; it crosses the os calcis in front of the long tendon, and is inserted to the projection or tubercle at the base of the fifth metatarsal bone, which forms such a prominent mark on the outer border of the foot.

NERVE SUPPLY.—From the musculo-cutaneous nerve.

ACTION.—It abducts, everts the foot, and helps to raise the heel in walking.

The **External Annular Ligament** is a strong part of the deep fascia attached to the outer side of the os calcis and external malleolus. It binds down and prevents dislocation of the two peroneal muscles which here lie in a synovial sheath. Each peroneal tendon, as it passes under the ligament, carries with it for some distance on the outer aspect of the os calcis a tubular prolongation of the common synovial cavity. The posterior peroneal artery also passes beneath the external annular ligament (Plate XXVIII).

Peroneus Quinti Digiti.—This small tendinous slip is only occasionally present. It rises with the peroneus brevis or from the fibula below it, and ends in the extensor aponeurosis of the little toe.

All the structures which have been examined on the extensor and outer aspects of the leg and foot are now to be cut away, with the exception of the anterior tibial artery and its branches and the tendons of the peroneal muscles.

DISSECTION XI

FLEXOR ASPECT OF THE LEG

In this dissection the great muscles which compose the calf of the leg are to be examined. The heel is the lever on which they act. They give the forward impetus in walking. Deep to the calf muscles lies a group which acts on the foot and toes. They, too, assist in flexing the ankle-joint and raising the body on the outstretched foot. Between the deep and superficial layers of muscles will be found the posterior tibial nerve and vessels (Plate XXXI). These are derived from the internal popliteal nerve and popliteal vessels.

In this dissection the leg is bound securely to one of the heavy blocks of wood used for elevating the body. The part is placed so as to allow the foot to hang over the end of the block. The dorsum of the foot is placed against the end surface of the block. Short nails are driven through the tips of the toes to secure the foot in this position. The upper part of the leg is bound down to the opposite end of the block. In this manner the part is secured for dissection.

The skin is reflected by making a median incision along the back of the leg to the lower border of the heel, and then raising an inner and outer flap. The skin flaps should be cut completely away. Only the skin of the sole now remains unremoved.

Cutaneous Nerves.—The following are found in the subcutaneous tissue of this part (fig. 94) :

- (1) Terminal twigs of the small sciatic.
- (2) Ramus communicans tibialis.
- (3) Ramus communicans fibularis.
- (4) Short saphenous.
- (5) Branches of the external popliteal nerve.

The terminal branches of the *small sciatic* nerve ramify over the upper third of the calf.

The *ramus communicans tibialis* of the internal popliteal nerve passes down in the interval between the heads of the gastrocnemius, and pierces the deep fascia just below the middle of the calf. Here it is joined by the *ramus communicans fibularis*, the short or external saphenous nerve being formed by their union (Plate XXIX). The *ramus communicans fibularis* arises from the external popliteal and crosses the outer head of the gastrocnemius.

The *short saphenous nerve* extends down behind the external malleolus, in company with the short saphenous vein, to reach the outer border of the dorsum of the foot. Its termination has been already seen on the toes (p. 208).

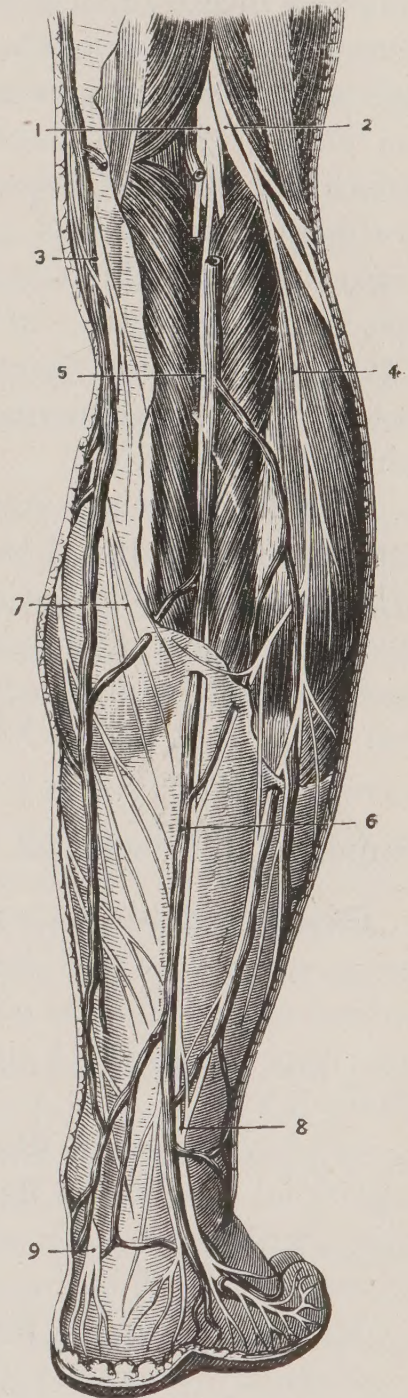
Cutaneous branches of the external popliteal nerve ramify over the outer part of the back of the leg. They also have been examined before (fig. 94).

Veins.—The *short saphenous vein* (Plate XXIX) commences in the outer part of the arch on the dorsum of the foot and passes behind the external malleolus to reach the back of the leg. It passes upwards on the gastrocnemius muscle and disappears between its two heads to open into the popliteal vein (see p. 150).

Deep Fascia.—The subcutaneous tissue, with the nerves and veins which lie in it, is to be cleaned away so as to display this fascia.

The deep fascia covers the superficial muscles of the back

FIG. 94.—SUPERFICIAL NERVES AND VEINS ON THE BACK OF THE LEG. (Hirschfeld and Leveillé.)



1. Internal popliteal nerve. 2. External popliteal nerve. 3. Internal saphena vein. 4. Nervus communicans peronei. 5. Upper part of short saphenous nerve. 6. External saphena vein. 7. Internal saphenous nerve. 8. Lower part of short or external saphenous nerve. 9. Posterior tibial nerve.

of the leg. It is attached on the inner side to the whole length of the tibia, from the internal tuberosity to the internal malleolus. It blends with the periosteum on the subcutaneous surface of the tibia. Externally, it is attached directly to the head and lower extremity of the fibula, and to the shaft of the fibula by means of an intermuscular septum which separates the muscles of the back of the leg from the peronei (see Plate XXVI). Below, it is continuous with the internal annular ligament at the ankle. A deep layer of fascia separates the superficial muscles of the calf (gastrocnemius, plantaris, and soleus) from the deep muscles and posterior tibial vessels and nerve (see Plate XXVI). The tibial vessels lie deep to this fascia; it is therefore a structure of some surgical importance. Another still deeper layer of fascia passes from the tibia to the fibula, forming a compartment in which the tibialis posticus is contained (Plate XXVI).

The deep fascia is now to be removed so as to display the muscles of the calf. The great tendo Achillis above the heel is to be freed and followed to its insertion. The internal annular ligament, however, should be left *in situ*. Beneath it the deep tendons, vessels, and nerves of the back of the leg enter the sole of the foot (Plate XXX).

Superficial Muscles of the Back of the Leg (Plate XXIX)

Gastrocnemius.—**ORIGIN.**—*Inner Head.*—From the posterior surface of the femur, immediately above the articular surface of the internal condyle. *Outer Head.*—From the outer and upper aspect of the external condyle of the femur (Plate XVII).

INSERTION.—The fibres of the two heads end below on the superficial aspect of a flat strong aponeurosis or tendon, which unites with the tendon of the soleus to form the *tendo Achillis* (Plate XXX). The inner head extends lower than the outer.

NERVE SUPPLY.—From the internal popliteal nerve.

ACTION.—It raises the heel and flexes the foot; it flexes the knee-joint.

SUB-SEMIMEMBRANOSUS BURSA.—A large and constant bursa lies between the inner head of the gastrocnemius and the tendon of the semimembranosus. This frequently communicates with the synovial membrane of the knee-joint.

The two heads of the gastrocnemius are to be raised, detached from the femur, and thrown down on the leg. A sesamoid bone occasionally occurs in the external head; a synovial bursa also may be found beneath one or both heads. When the heads are detached it will be seen that they rest on the thin parts of the capsule of the joint which cover the posterior ends of the condyles. The thin parts of the capsular ligament covering the convexities of the condyles act as bursæ for the heads of the gastrocnemius muscle.

Plantaris.—If care is not taken, the plantaris, which arises with the external head of the gastrocnemius, may be detached with it. The plantaris is a vestigial muscle and is not infrequently absent.

ORIGIN.—By fleshy fibres from the posterior surface of the femur, immediately above the articular surface of the external condyle (Plate XVII).

INSERTION.—Its long tendon is *inserted* to the posterior and inner part of the os calcis, close to the tendo Achillis. The tendon, which can be stretched laterally to a great width, lies between the gastrocnemius and soleus. The muscle should be detached when examined. It is supplied from the internal popliteal nerve.

Soleus.—**ORIGIN** (Plate XXXII). From (1) the posterior surface of the head and upper third of the shaft of the fibula; (2) from the oblique line of the tibia, and two or three inches of the inner border of the tibia; and (3) from a fibrous arch which lies over the posterior tibial vessels and nerve and unites the two other points of origin.

INSERTION.—Its aponeurosis or tendon of insertion joins with that of the gastrocnemius to form the tendo Achillis.

NERVE SUPPLY.—By one branch from the internal popliteal and another from the posterior tibial nerve.

ACTION.—It raises the heel and flexes the foot; it mainly gives the quick, jerky impulse in walking.

The soleus should now be raised from its origin; care has to be taken in detaching it, so as to leave uninjured the posterior tibial vessels and nerves and fascia beneath (Plate XXXI). The separation should be conducted from below upwards; the muscle is easily detached from the deep structures below, where its tendon joins with that of the gastrocnemius.

PLATE. XXIX.

STRUCTURES IN THE CALF OF THE LEG.

Muscles and Tendons.

- A. Outer head of gastrocnemius.
- B. Inner head of gastrocnemius.
- C. Flexor longus digitorum.
- D. Flexor longus hallucis.
- E. Peroneus longus.
- G. Peroneus brevis.
- H. Tendo Achillis.
- J. Tendon of semitendinosus.

Nerves.

- 1. Communicans fibularis.
- 2. Communicans tibialis.
- 3. External saphenous.
- 4. Posterior tibial.

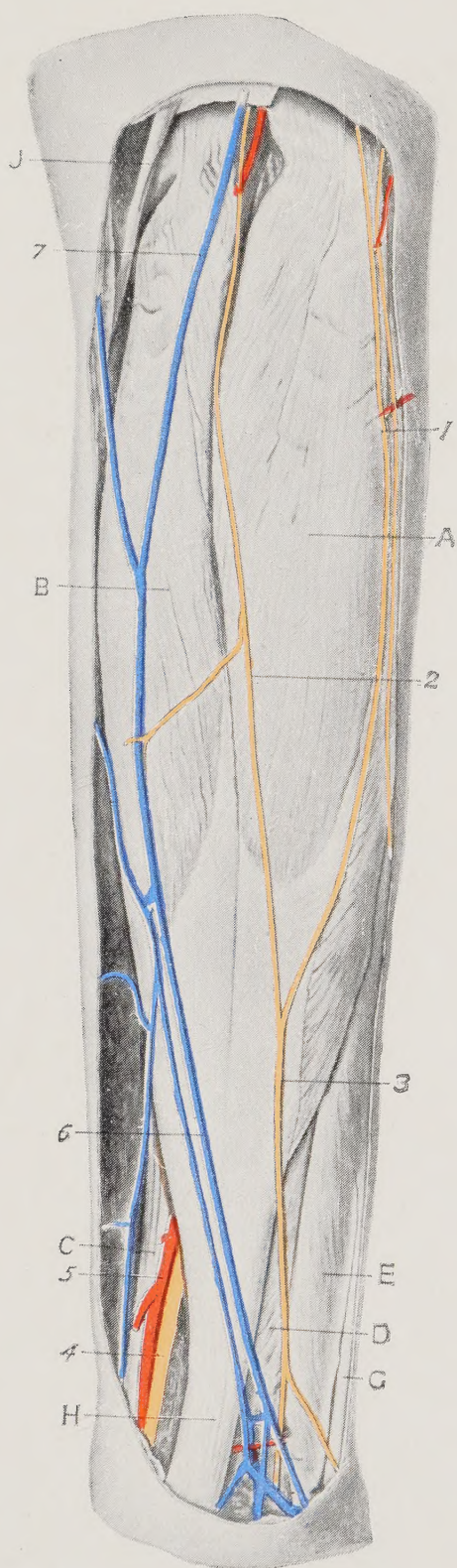
Artery.

- 5. Posterior tibial.

Veins.

- 6. External saphenous communicating with
internal saphenous.
- 7. External saphenous.

PLATE XXIX,



STRUCTURE OF THE SOLEUS.—When the deep surface of the soleus is examined the arrangement of its fibres will be seen to be highly complicated. The fibres of the muscle are extremely numerous and very short; the effect of this is to give a short but powerful movement to the heel. There are two tendons or septa of origin and two of insertion. One of the tendons of insertion is seen on the superficial aspect of the muscle, passing to the tendo Achillis; the other tendon of insertion is seen, or rather its edge is seen, in the middle of the deep surface of the soleus. One tendon of origin is attached to the fibula, the other to the oblique line of the tibia; the short oblique fibres pass from the two tendons of origin to the two tendons of insertion.

Tendo Achillis (Plate XXX).—The tendo Achillis is inserted into the middle part of the posterior surface of the os calcis, a bursa intervening between the tendon and the smooth upper part of the bone. Although the tendo Achillis is of great strength, it is occasionally ruptured. Near its insertion the fibres have a twisted rope-like appearance (Parsons).

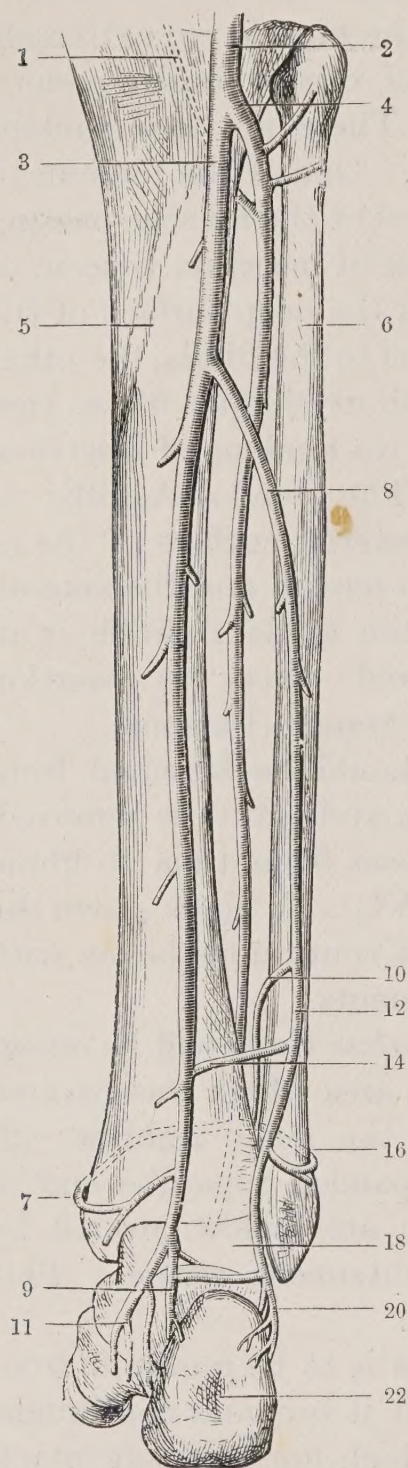
DISSECTION.—The tendo Achillis should be detached from the heel, and the gastrocnemius, soleus, and plantaris removed. A strong aponeurotic layer is seen to pass from tibia to fibula beneath the tendo Achillis (Plate XXVI). It binds down the deep muscles and tendons, and becomes continuous below with the internal and external annular ligaments.

On the *posterior surface of the os calcis* there will be recognised three areas: (1) an upper smooth area which was covered by the bursa beneath the insertion of the tendo Achillis; (2) a rough middle area to which the expanded rope-like end of the tendo Achillis was inserted; (3) an area below covered by skin and dense, granular, fatty, subcutaneous tissue. This area comes in contact with the ground.

The deep aponeurotic layer of fascia is to be removed from the popliteus right down the leg, until it becomes continuous with the internal annular ligament, which must be left intact. The internal calcanean artery and nerve will be found perforating the ligament (Plate XXXIII). The posterior tibial artery and its branches are now to be traced. The venæ comites which closely surround the arteries of the leg, often greatly dilated and varicose, are also to be removed.

Termination of the Popliteal Artery (Plate XXXI).—At the lower border of the popliteus muscle the popliteal artery

FIG. 95.—THE ARTERIES OF THE LEG AND ANKLE. (Anderson.)



1. Anterior tibial recurrent. 2. Popliteal.
3. Posterior tibial, giving off muscular and medullary branches. 4. Anterior tibial, giving off posterior tibial recurrent and superior fibular before piercing interosseous membrane and anterior tibial afterwards. 5. Tibia.
6. Fibula. 7. Anastomosis of internal malleolar of anterior tibial with posterior internal malleolar. 8. Peroneal.
9. Internal calcanean. 10. Anterior peroneal. 11. Internal and external plantar.
12. Posterior peroneal. 14. Communicating. 16. External malleolar of anterior tibial joining posterior peroneal. 18. Astragalus. 20. External calcanean. 22. Calcaneum.

divides into anterior and posterior tibial arteries. The origin of the anterior tibial artery should now be examined. It is closely surrounded by muscles and is difficult of dissection. Before it passes the interosseus membrane it gives off two branches—the *posterior tibial recurrent* and *superior fibular*.

Posterior Tibial Artery.—A line drawn from the middle of the popliteal space to a point midway between the inner malleolus and os calcis marks the course of the artery. The posterior tibial artery commences at the bifurcation of the popliteal artery, opposite the lower border of the popliteus. It extends to a point between the inner tuberosity of the os calcis and the inner malleolus, where it terminates by dividing into the two plantar arteries (fig. 95).

RELATIONS (Plate XXXI).—*Superficial.* In its upper two thirds the artery lies deeply under the superficial muscles of the calf and the deep layer of fascia. It is crossed near its commencement by the posterior tibial nerve. In its lower third the vessel is superficial. It lies between the inner border of the tibia and the tendo Achillis, and is covered merely by skin and fascia. At its termination it lies under the internal annular ligament (Plate XXXIII).

Lateral. The posterior tibial

nerve lies at first to its inner side, but soon crosses over the vessel to lie on its outer side. Venæ comites surround the artery. The *deep* surface of the artery rests successively on the tibialis posticus, flexor longus digitorum, tibia and ankle-joint.

BRANCHES.—(1) *Muscular* to the muscles of the back of the leg.

(2) *Peroneal* (fig. 95).

(3) *Medullary*, a large branch to the tibia.

(4) *Communicating* to join a corresponding branch of the peroneal artery on the lower end of the tibia, under the tendon of the tibialis posticus.

(5) *Internal calcanean* branches which pierce the internal annular ligament to reach the skin of the heel and sole of the foot.

(6) *Internal malleolar*.

(7) *Cutaneous*.

Peroneal Artery.—This is a large branch which arises from the posterior tibial artery about an inch and a half below its commencement (Plate XXXI). It passes down in close relation to the fibula, and partly in the substance of the flexor longus hallucis, being accompanied by the nerve to that muscle. Fibrous tissue binds it so closely to the fibula that in fracture of that bone the artery can scarcely escape injury. About an inch and a half above the ankle it divides into anterior and posterior terminal branches (fig. 95).

BRANCHES.—(a) *Muscular* branches to the adjacent muscles.

(b) *Medullary* branch to the fibula.

(c) *Communicating* branch which joins the corresponding branch of the posterior tibial artery.

(d) *Anterior Terminal* or *Anterior Peroneal*.—This passes through the lower part of the interosseus membrane, and reaches the front of the ankle, where it anastomoses with the external malleolar artery (Plate XXV) and terminates on the outside of the foot by joining with branches of the tarsal artery. It may be of large size and replace the anterior tibial artery at the ankle.

(e) *Posterior Terminal* or *Posterior Peroneal*.—This branch is continued down on the posterior surface of the inferior tibio-fibular joint and reaches the outer surface of the os calcis, where it anastomoses with the external malleolar, tarsal, and external plantar arteries (Plate XXX).

PLATE XXX.

STRUCTURES ON THE POSTERIOR ASPECT OF THE ANKLE-JOINT.

Arteries.

- A. Posterior tibial.
- B. Internal calcanean.
- C. Posterior peroneal.
- D. Point of division of the posterior tibial.

Vein.

- E. External saphenous.

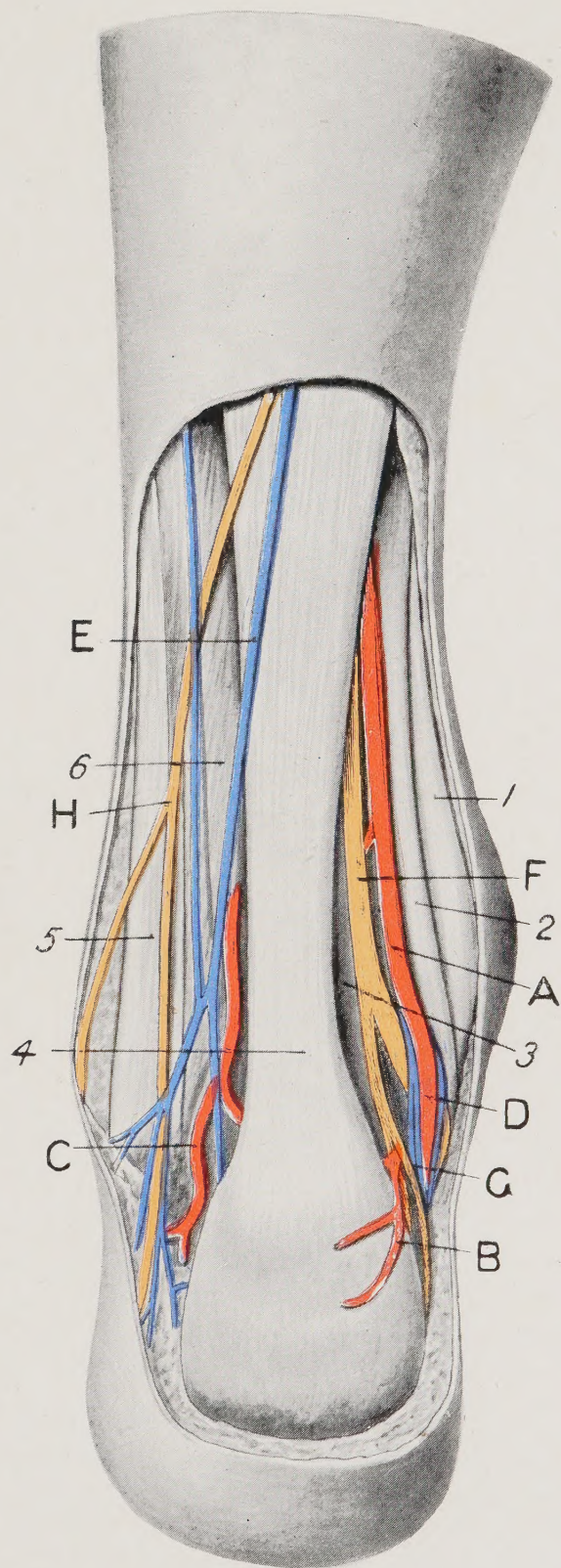
Nerves.

- F. Posterior tibial.
- G. Internal calcanean.
- H. External saphenous.

Tendons.

- 1. Tibialis posticus.
- 2. Flexor longus digitorum.
- 3. Flexor longus hallucis.
- 4. Tendo Achillis.
- 5. Peroneus longus.
- 6. Peroneus brevis.

PLATE XXX.



Periarticular Anastomosis of the Ankle (fig. 95).—The following arteries have been now traced to the anastomosis round the ankle-joint: (1) The internal and external malleolar branches of the anterior tibial; (2) the internal malleolar branch of the posterior tibial; (3) the anterior and posterior peroneal arteries; (4) the tarsal branch of the dorsal artery of the foot.

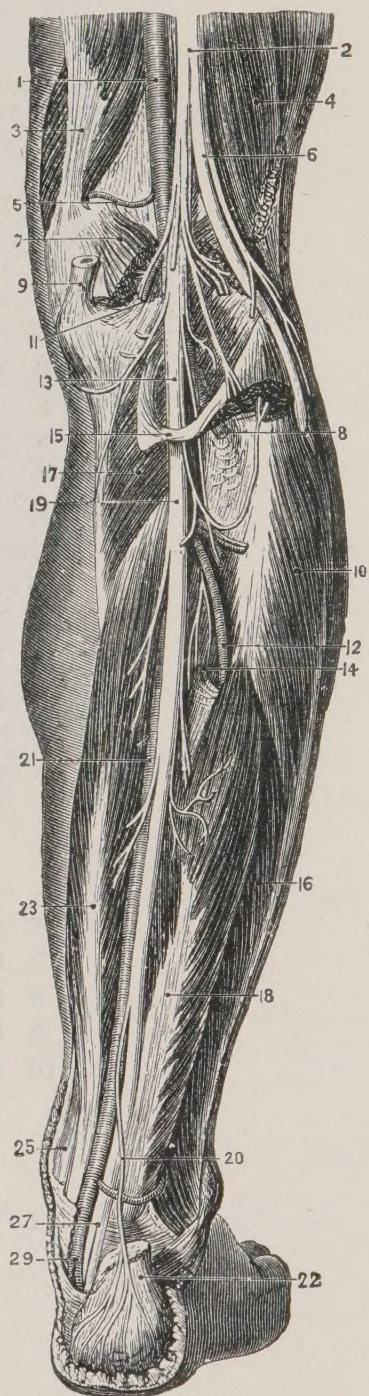
Posterior Tibial Nerve (fig. 96).—The posterior tibial nerve is the direct continuation of the internal popliteal nerve. It commences at the lower border of the popliteus muscle; it ends beneath the internal annular ligament by dividing into external and internal plantar nerves. It accompanies the posterior tibial artery, between the deep and superficial muscle of the back of the leg. At its commencement it lies to the inner side, and at its termination to the outer side of the artery; it lies over the artery in the middle of the leg.

BRANCHES.—(1) *Muscular* to the soleus, tibialis posticus, flexor longus digitorum and flexor longus hallucis. The branch to the last muscle accompanies the peroneal artery, and is distinguished as the *fibular* branch.

(2) Branches to the *medulla* and *periosteum* of the tibia and fibula.

(3) A branch to the *ankle-joint*; it enters the joint as the nerve crosses the capsular ligament.

FIG. 96.—THE POSTERIOR TIBIAL NERVE AND ITS BRANCHES. (Hirschfeld and Leveillé.)



1. Popliteal artery. 2. Great sciatic nerve. 3. Adductor magnus. 4. Biceps. 5. Superior internal articular artery. 6. External popliteal nerve. 7. Gastrocnemius (cut). 8. Anterior tibial artery. 9. Tendon of semimembranosus. 10. Peroneus longus. 11. Sural arteries and nerves. 12. Peroneal artery. 13. Internal popliteal nerve. 14. Tibialis posticus. 15. Portion of soleus. 16. Peroneus brevis. 17. Popliteus. 18. Flexor longus hallucis. 19. Posterior tibial nerve. 20. Calcanean branch of posterior tibial nerve. 21. Posterior tibial artery. 22. Tendo Achillis. 23. Flexor longus digitorum. 25. Tendon of tibialis posticus. 27. Plantar nerves. 29. Plantar arteries.

PLATE XXXI.

DEEP STRUCTURES ON THE BACK OF THE LEG.

Muscles.

- A. Outer head of gastrocnemius.
- B. Soleus.
- C. Flexor longus digitorum.
- D. Tibialis posticus.
- E. Flexor longus hallucis.
- F. Peroneus brevis.
- G. Peroneus longus.
- H. Tendo Achillis.

Nerves.

- 1. Fibular branch of posterior tibial.
- 2. Posterior tibial.
- 3. Lower nerve to soleus.
- 5. External saphenous.

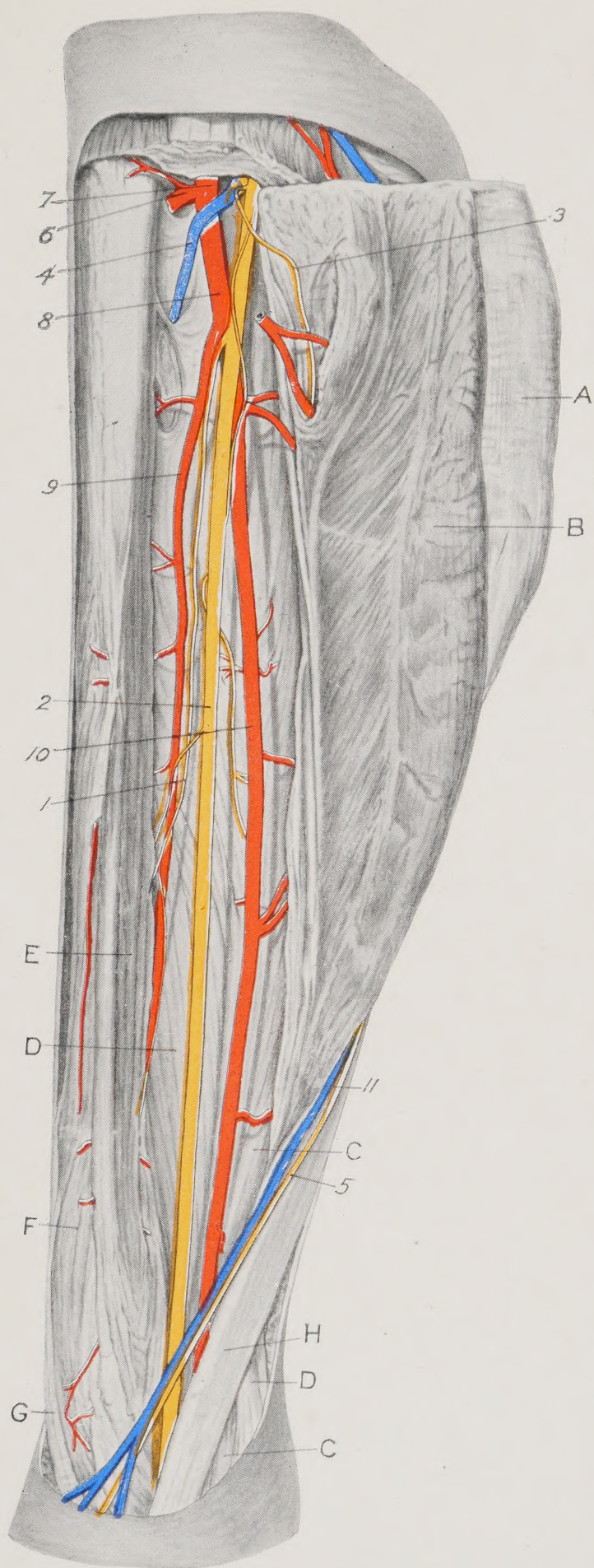
Arteries.

- 6. Anterior tibial.
- 7. Bifurcation of poplitea
- 8. Posterior tibial.
- 9. Peroneal.
- 10. Posterior tibial.

Vein.

- 11. External saphenous.

PLATE XXXI.



(4) The *internal calcanean* branch perforates the internal annular ligament and is distributed to the skin on the inner and under surface of the heel (fig. 96).

The posterior tibial nerve and artery should now be cut and thrown downwards. The four deep muscles on the back of the leg are to be cleaned and examined.

POPLITEAL FASCIA.—The popliteus, situate in the upper part of the leg, is covered by the deep layer of fascia. This, however, is strengthened by fibrous fasciculi derived from the insertion of the semimembranosus, and is distinguished as the popliteal fascia. This fascia is now to be removed. It is attached to the oblique line of the tibia.

Deep Muscles of the Back of the Leg.—These are the (1) popliteus, (2) flexor longus digitorum, (3) flexor longus hallucis, and (4) tibialis posticus (Plate XXXII).

Popliteus.—**ORIGIN.** By a narrow tendon from the anterior part of a groove on the outer surface of the external condyle of the femur (Plate XVII and fig. 97).

INSERTION.—By fleshy fibres into the posterior surface of the tibia above the oblique line.

The tendon of the popliteus arises within the capsule of the knee-joint, and lies underneath the external lateral ligament. It rests in a groove on the external condyle when the knee is flexed, but during extension it leaves the groove and plays on the round smooth border of the external condyle of the femur. The tendon also grooves the external semilunar cartilage and the posterior surface of the external tuberosity of the tibia.

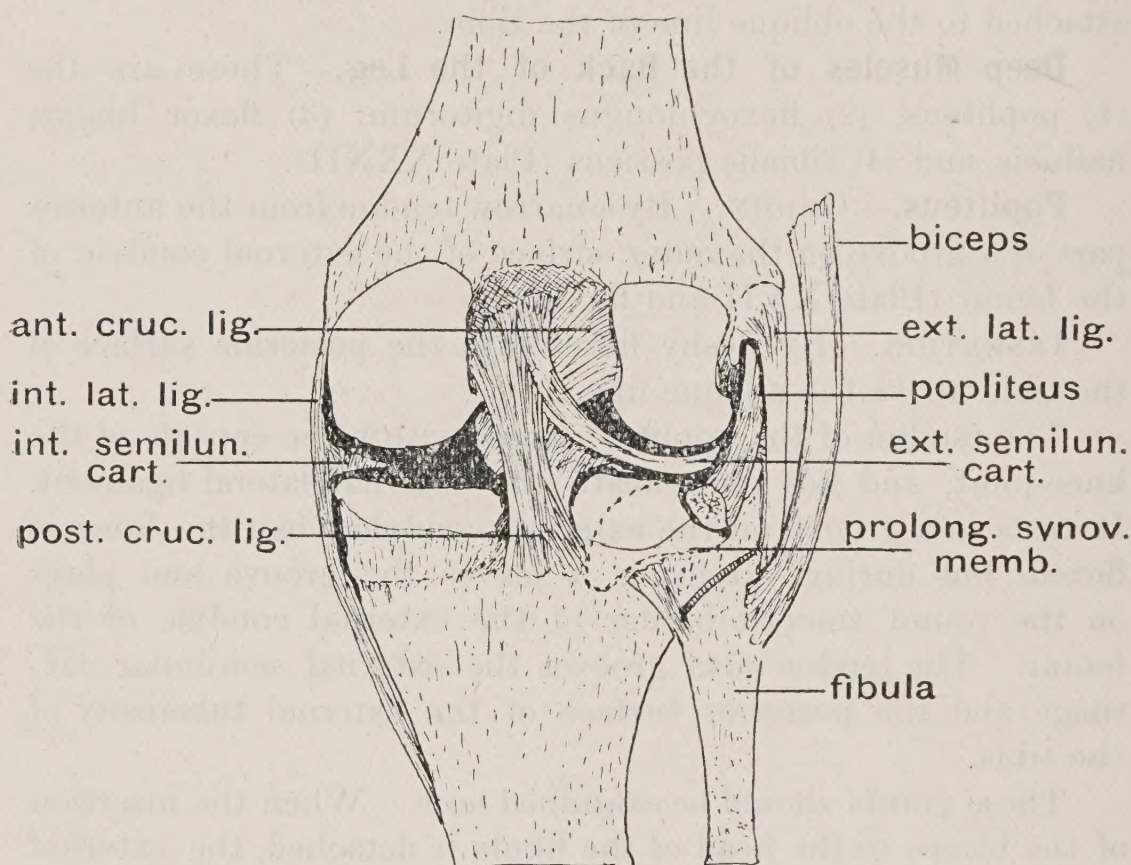
These points should be examined now. When the insertion of the biceps to the head of the fibula is detached, the external lateral ligament of the ankle-joint is seen beneath it. A bursa may separate them. The ligament is to be defined, the capsular fibres in front of it and behind it being cleaned away until the tendon of the popliteus is exposed (fig. 97). The outer surface of the tendon adheres to the capsule, but its inner surface is covered with the synovial membrane of the joint. The tendon grooves and is attached to the circumference of the external semilunar cartilage. When the muscle is detached at its insertion to the tibia and turned upwards, a prolongation of the synovial membrane of the knee-joint will be found beneath the tendon as it emerges from the knee-joint. There is also a

smooth impression on the margin of the external tuberosity corresponding to the tendon.

NERVE SUPPLY.—By a nerve from the internal popliteal which turns round the lower border of the muscle and enters the deep surface. This nerve also supplies the superior tibio-fibular joint.

ACTION.—It flexes the knee-joint; if the tibia is fixed it rotates the femur outwards; if the femur is fixed it rotates the tibia and foot inwards.

FIG. 97.—SHOWING THE ORIGIN OF THE TENDON OF THE POPLITEUS WITHIN THE KNEE-JOINT.

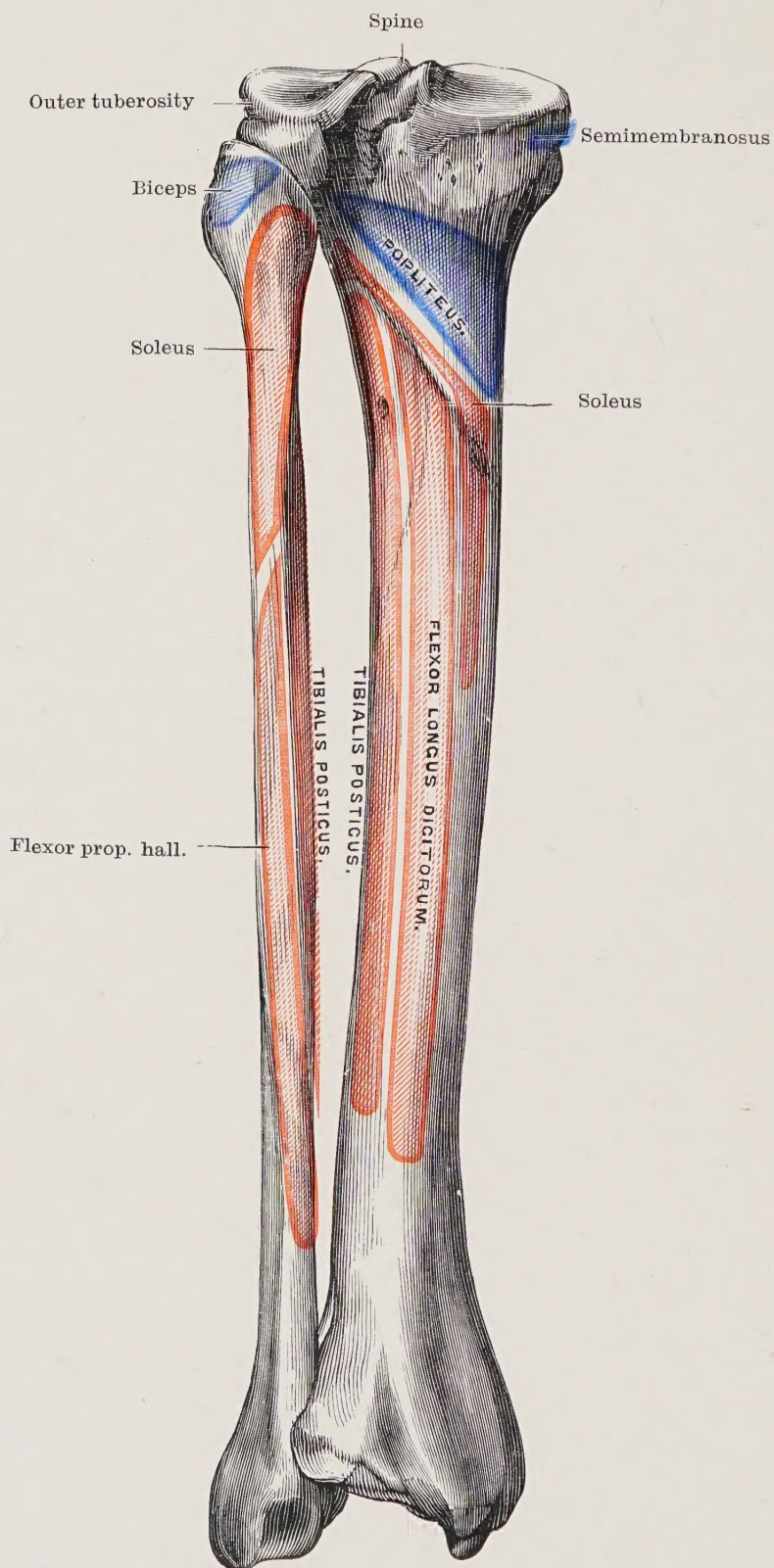


Flexor Longus Digitorum (Plate XXXI).—**ORIGIN.** From the posterior surface of the tibia below the oblique line, internal to the tibialis posticus, and from the aponeurosis of that muscle.

INSERTION.—Above the ankle the tendon of the tibialis posticus passes between the tendon of this muscle and the tibia (Plate XXX). The tendon reaches the sole of the foot by passing under the internal annular ligament. In the sole of the foot it forms a triangular expansion, which is joined by the accessorius (Plate XXXV), and is inserted by four tendons to the terminal phalanges of the four outer toes. (See p. 250.)

PLATE XXXII.

THE POINTS OF MUSCULAR ATTACHMENT ON THE FLEXOR
ASPECT OF THE TIBIA AND FIBULA. (*After Holden.*)



NERVE SUPPLY.—From the posterior tibial.

ACTION.—It flexes the ankle-joint, foot, and toes. In walking it helps to raise the heel and foot.

Flexor Longus Hallucis (Plate XXXI).—ORIGIN. From the posterior surface of the fibula, below the origin of the soleus and from the aponeurosis of the tibialis posticus.

INSERTION.—Its tendon passes over the capsule of the ankle-joint under the internal annular ligament, and grooves the astragalus and sustentaculum tali. It is inserted into the base of the terminal phalanx of the great toe.

NERVE SUPPLY.—From the posterior tibial nerve.

ACTION.—In its course from the fibula to the great toe, the tendon of this muscle passes under the ankle-joint. The great toe is the chief fulcrum on which the leg rests as a forward step is taken. The central position of the tendon under the ankle-joint allows it to act with advantage in raising the foot and heel and in flexing the great toe.

Tibialis Posticus.—ORIGIN (Plate XXXII). From the posterior surface of the interosseus membrane and adjacent portions of the tibia and fibula, and from a strong aponeurosis on its superficial aspect.

INSERTION.—Its strong tendon passes under the tendon of the flexor longus digitorum, and enters a deep groove behind the internal malleolus (Plate XXXIII). It then lies on the surface of the internal lateral ligament and the inferior calcaneo-scaphoid ligament, both of which it supports. It is inserted mainly to the tubercle of the scaphoid bone, slips also being given off to the sustentaculum tali, cuboid, and three cuneiform bones, and to the bases of the second, third, and fourth metatarsal bones.

NERVE SUPPLY.—From the posterior tibial.

ACTION.—It flexes the ankle-joint and inverts the foot. It helps to support and maintain the arch of the foot.

Structures on the Inner Side of the Ankle (Plates XXX and XXXIII). **INTERNAL ANNULAR LIGAMENT**.—This is a thickened portion of the deep fascia stretching from the internal malleolus to the inner border of the os calcis. Below, it gives attachment to the abductor hallucis muscle. It is pierced by the internal calcanean branches of the posterior tibial vessels and nerve.

STRUCTURES ENTERING THE SOLE OF THE FOOT.—Passing

PLATE XXXIII.

STRUCTURES ON THE INNER ASPECT OF THE ANKLE-JOINT.

Muscles and Tendons.

- A. Abductor hallucis.
- B. Flexor longus digitorum.
- C. Tibialis posticus.
- D. Tibialis anticus.
- E. Flexor longus hallucis.
- F. Tendo Achillis.

Ligaments.

- G. Lower limb of anterior inferior annular.
- H. Insertion of internal lateral to Sustentaculum tali.
- J. Internal lateral of ankle-joint.

Artery.

- 1. Posterior tibial.

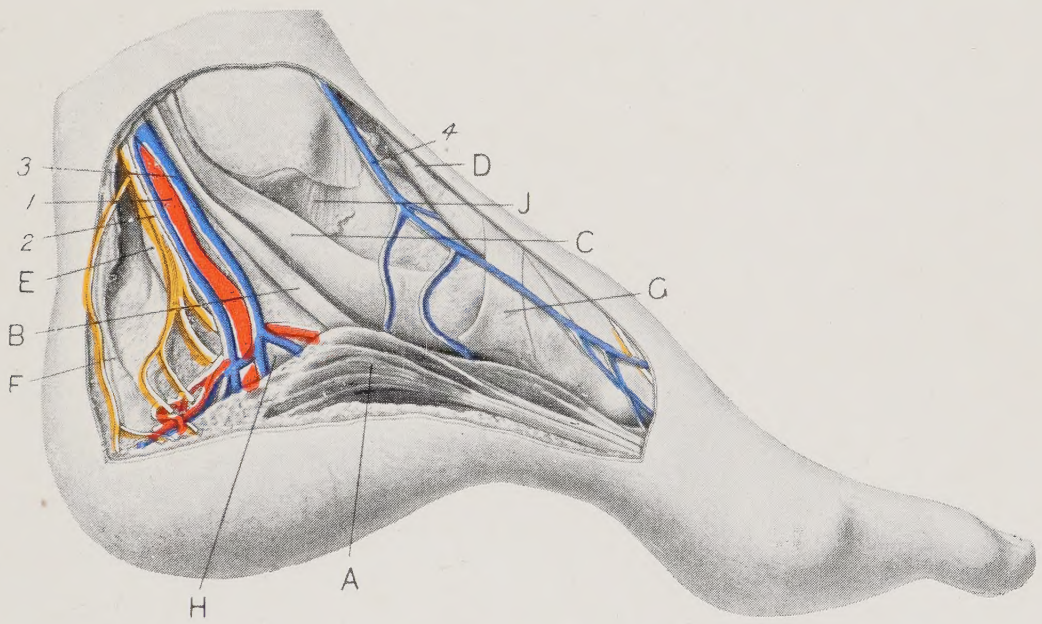
Nerve.

- 2. Posterior tibial.

Veins.

- 3. Posterior tibial.
- 4. Internal saphenous.

PLATE XXXIII.



underneath the internal annular ligament are a number of structures which reach the sole of the foot in the following successive order from within outwards (Plate XXXIII) :

- (1) Tendon of *tibialis posticus*.
- (2) Tendon of *flexor longus digitorum*.
- (3) Posterior tibial artery with *venæ comites*.
- (4) Posterior tibial nerve.
- (5) Tendon of *flexor longus hallucis*.

Each tendon as it passes under the ankle-joint lies within a synovial sheath. Within these sheaths the tendons move smoothly. Inflammatory conditions, such as may result from sprained ankle or fracture of the lower end of the fibula or tibia, are apt to lead to adhesions between the tendons and their sheaths. The result is that movement becomes limited and painful, and the joint stiff. The annular ligament retains the structures beneath it in position.

The internal annular ligament should be cut through and the synovial sheaths and relationships of the tendons examined. The position of the posterior tibial artery may be indicated at the ankle by taking a point midway between the internal malleolus and internal tuberosity of the *os calcis*.

The three deep flexor muscles are left in position so that their insertions may be studied in the dissection of the sole.

It is better now to turn to an examination of the knee-joint, the largest, most complicated, and, from a surgical point of view, the most important joint in the body.

DISSECTION XII

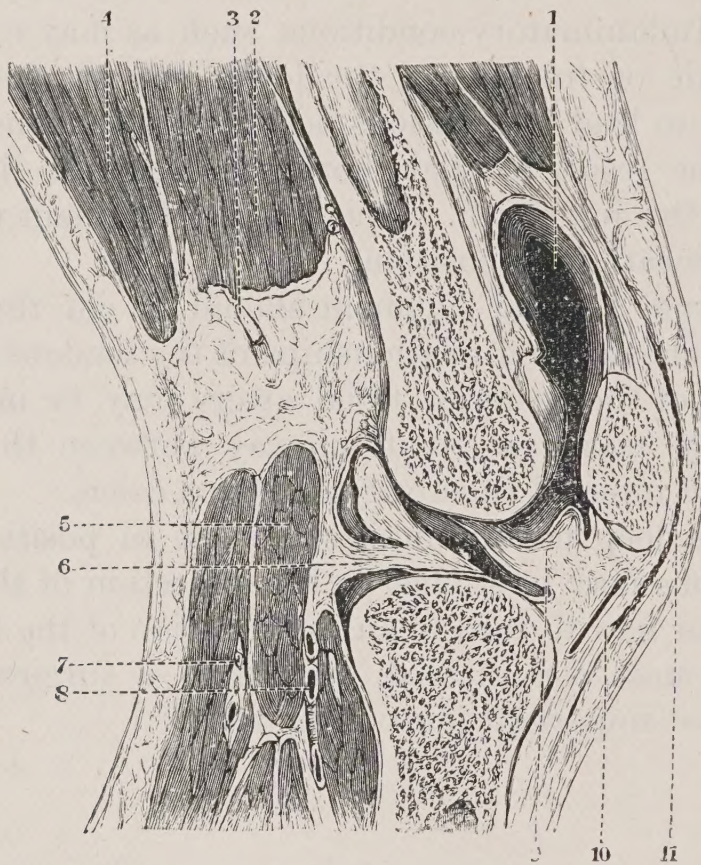
THE KNEE-JOINT

The Ligaments of the Joint.—These are: (1) The Internal lateral; (2) External lateral; (3) Posterior; (4) Anterior; (5) Crucial. These ligaments bind the femur to the tibia and fibula; the four first named enclose the cavity of the joint.

I. Internal Lateral Ligament.—The dissector should turn at once to the examination of this ligament on the inner side of the knee-joint (Plate XXI). It is a wide, flat

aponeurotic band, with important functions and relationships. It is attached above to the tuberosity of the internal condyle and below to the internal tuberosity and inner aspect of the upper part of the shaft of the tibia. Its deep short fibres end on the internal tuberosity of the tibia. It is tense when the joint is extended, keeping the internal condyle of the femur and internal tuberosity of the tibia firmly in apposition. When its anterior and posterior borders are defined by cutting away the

FIG. 98.—VERTICAL SECTION OF THE KNEE-JOINT, TO SHOW THE CAVITY OF THE JOINT WHICH HAS BEEN ARTIFICIALLY DISTENDED BY INJECTION. (*Braune.*)



1. Synovial membrane. 2. Short head of biceps. 3. Peroneal nerve. 4. Long head of biceps.
5. Plantaris. 6. External semilunar cartilage. 7. Sural vessels. 8. Popliteal vessels.
9. Anterior crucial ligament with bursa subpatellaris. 10. Ligamentum patellæ. 11. Bursa præpatellaris.

capsular fibres, the outer convex margin of the internal semilunar cartilage will be seen attached to the deep surface of the lateral ligament (fig. 97). In complete extension the internal lateral ligament is tense, and the cartilage is wedged firmly between the two opposing surfaces of the femur and tibia. When the joint is flexed—even a little—the internal lateral ligament relaxes, the bones are not kept so firmly in apposition, and the semilunar cartilage is less firmly wedged and

therefore more liable to become dislocated. Dislocation of this cartilage occurs in the flexed position of the joint.

RELATIONSHIP TO MUSCLES (Plate XXI).—(1) The tendon of the semimembranosus should be followed to its insertion under the ligament. Beneath the insertion of the tendon is a bursa.

(2) The popliteus passes at its insertion some distance beneath the ligament.

(3) Over the termination of the ligament will be found the insertions of three muscles : the sartorius, gracilis, and semitendinosus. These should be again examined, the bursæ beneath the sartorius and gracilis being noted at the same time. From their position at the posterior and inner aspect of the joint, it will be seen that the five muscles, inserted on the inner and posterior aspect of the tibia, over or under the internal lateral ligament, must act not only as flexors of the knee-joint, but will also tend to rotate the tibia inwards during flexion of the joint.

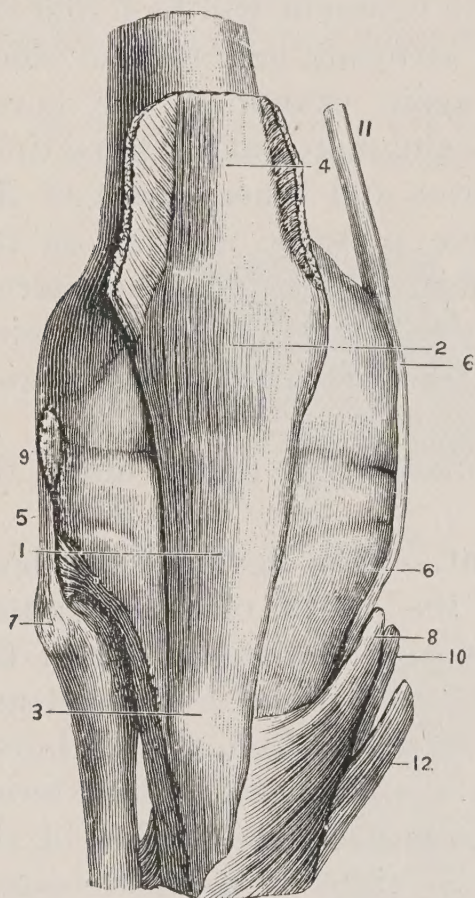
(4) The inferior internal articular artery passes under the ligament.

II. External Lateral Ligament.—This ligament has been already defined in order to see the origin of the popliteus beneath it (Plate XX). It passes from the tuberosity of the external condyle to the head of the fibula, and is rounded and cord-like. The biceps tendon is separated from it by a bursa. An accessory fasciculus lies behind the ligament. The external semilunar cartilage is separated from it by the tendon of the popliteus (fig. 97). The ligament is tight in complete extension ; the more the joint is extended the tighter it becomes, and the more firmly is the external semilunar cartilage wedged between the external condyle and the external tuberosity. The inferior external articular artery passes beneath it.

III. Posterior Ligament.—When the knee-joint is extended this rather membranous ligament will be found filling the inter-condylar space and passing from the femur above to the margin of the head of the tibia below. It prevents over-extension ; in flexion it is lax. Laterally, where the posterior ligament covers the posterior extremities of the condyles, it becomes lax, thin and capsular. Over its thin lateral parts arise the heads of the gastrocnemius, a muscle which acts as a powerful flexor of the joint. Some of the bursæ in this region, especially that between the semimembranosus and

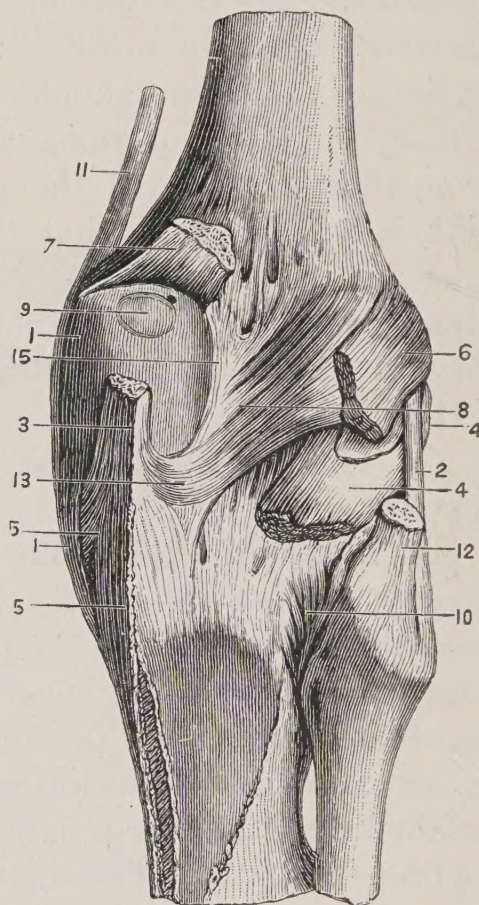
inner head of the gastrocnemius, may communicate through the ligament with the cavity of the joint. On each side the posterior ligament passes outwards to the lateral ligaments. A strong band of fibres from the insertion of the semimem-

FIG. 99.—ANTERIOR VIEW OF THE
LIGAMENTS OF THE KNEE-JOINT.
(Sappey.)



1. Ligamentum patellæ (the lateral patellar ligaments have been removed). 2. Patella covered by tendinous fibres derived from the rectus and vasti. 3. Tubercle of tibia. 4. Tendon of rectus with vasti. 5. Long external lateral ligament. 6, 6. Internal lateral ligament. 7. Bicipital tuberosity of head of fibula receiving attachment of long external lateral ligament. 8. Insertion of sartorius. 9. Tendon of popliteus. 10. Insertion of gracilis. 11. Tendon of adductor magnus prolonged into internal lateral ligament. 12. Insertion of semitendinosus.

FIG. 100.—POSTERIOR VIEW OF THE
LIGAMENTS OF THE KNEE-JOINT.
(Sappey.)



- 1, 1. Internal lateral ligament. 2. Long external lateral ligament. (The short external lateral ligament should be shown on the inner side of this, connected with the popliteus tendon.) 3. Tendon of semimembranosus. 4, 4. Popliteus tendon. (An aperture in the capsule lies beneath this tendon.) 5, 5. Prolongations of tendon of semimembranosus. 6. Outer head of gastrocnemius. 7. Inner head of gastrocnemius. 8. Posterior ligament (of Winslow). 9. Opening in capsule. 10. Posterior superior tibio-fibular ligament. 11. Tendon of adductor magnus. 12. Tendon of biceps. 13. Prolongation from tendon of semimembranosus to posterior ligament. 15. Posterior ligament (of Winslow).

branosus (ligament of Winslow) joins and strengthens the posterior ligament (fig. 100). On its deep surface, the posterior ligament is in contact with the posterior crucial ligament and semilunar cartilages.

IV. **Anterior Ligaments** (fig. 99).—These ligaments, which compose the anterior part of the capsule, have already been examined in connection with the quadriceps extensor cruris (p. 196). The anterior part of the capsule of the joint is made up of: (a) Ligamentum patellæ; (b) Patella; (c) Suprapatellar tendon—common tendon of insertion of quadriceps to the patella; (d) Lateral patellar ligaments; (e) Capsular ligament between the ligamentum patellæ and lateral ligaments of the joint. The two ligaments last named are continuous, the first (d) filling up the intervals between the patella and condyles of the femur, the second (e) occupying the spaces between the ligamentum patellæ and the lateral ligaments.

When the joint becomes filled with fluid the comparatively loose and thin lateral patellar ligaments become distended and the lateral patellar grooves lost (fig. 98). The patella then rests as on a water-cushion.

V. **Crucial Ligaments** (figs. 97 and 101).—The joint is now to be thrown freely open in front by detaching and throwing down the anterior ligaments and patella from the lower extremity of the femur.

The *anterior crucial ligament* is seen to lie almost free within the joint, passing upwards, outwards, and backwards. It is attached below to the upper surface of the tibia, in front of the tibial spine and between the articular impressions for the condyles; above, it is attached to the outer side of the inter-condylar notch. The ligament prevents over-extension; it becomes lax as the joint is flexed.

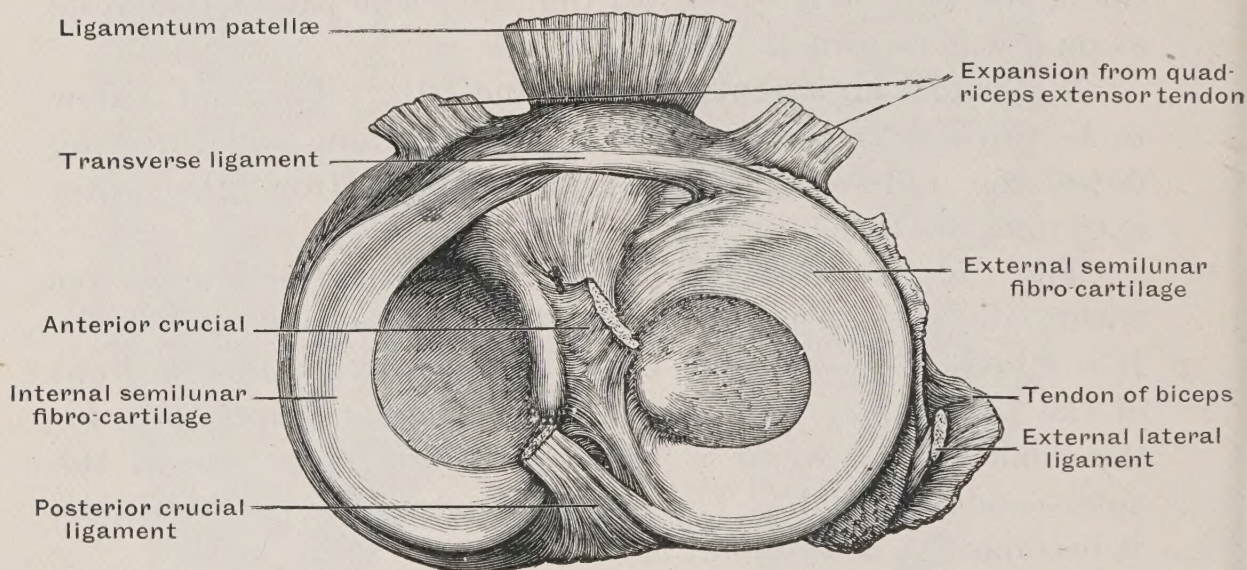
The anterior crucial ligament is now detached from the tibia; the *posterior crucial ligament* is then seen passing from the upper surface of the tibia behind the tibial spine to the intercondylar notch of the femur, to which it is inserted on the inner and anterior aspect. This ligament becomes tense on complete extension and also in complete flexion. Its posterior aspect is continuous with the posterior ligament of the joint. The synovial membrane is reflected round both crucial ligaments, which thus divide the posterior part of the joint cavity into two condylar recesses.

ROTATION.—It will be thus seen that all the ligaments of the joint become tense in extension, and that rotatory movements between the femur and tibia are then impossible. The ligaments are most lax in mid-flexion, and in that position it

will be found that a considerable degree of rotatory and lateral movements is permitted, and it is in this position that dislocation and internal derangements of the knee-joint are most liable to occur.

VI. Semilunar Cartilages (fig. 101).—The joint should be completely flexed to expose these cartilages, which are wedged in between the margins of the articular surfaces of the femur and tibia, so as to adapt them together and, at the same time, act as buffers. Too much attention cannot be paid to the manner in which these cartilages act and are held in position; for, as the student already knows, dislocation of these is a common and serious accident which overtakes athletes.

FIG. 101.—THE TIBIAL ATTACHMENTS OF THE SEMILUNAR CARTILAGES AND CRUCIAL LIGAMENTS. (*From Morris's 'Anatomy.'*)



It is the anterior horn of the *internal semilunar cartilage* that is most frequently detached in accident. This crescentic fibro-cartilage—forming about half a circle—is attached thus: (1) Its anterior horn is attached to the inter-articular space in front of the tibial spine and anterior crucial ligament. (2) Its posterior end is attached to the inter-articular space behind the tibial spine. (3) Its circumference is attached to the internal lateral and capsular ligaments, the attaching fibres forming the *coronary ligament*. (4) A *transverse ligament* (fig. 101) passes between the anterior extremities of the two semilunar cartilages.

The *external semilunar cartilage* forms three-fourths of a circle and is seldom dislocated. It is attached (1) by its extremities in front of and behind the anterior tibial spine.

(2) Its posterior extremity also ends partly in the posterior crucial ligament. (3) Its circumference is attached by *coronary* fibres (fig. 97) to the capsular ligaments of the joint and to the popliteus tendon which grooves it.

A groove will be seen on each side of the articular end of the femur, between the condylar and the trochlear surfaces, into which the anterior margins of the cartilages are wedged in complete extension. On section, each cartilage is wedge-shaped. The base is attached by coronary fibres to the capsule of the joint, while the upper and lower surfaces project within the joint and are covered by synovial membrane. Only gliding movements take place between the cartilages and the tibia; they glide backwards as the joint is flexed, and forwards as it is extended; the condyles of the femur roll on their upper surfaces.

VII. Synovial Membrane and its Ligaments (fig. 98).—The synovial membrane of the knee-joint is extensive, especially in front. It lines the inner aspect of the anterior capsular ligament from the margins of the patella to the margins of the condyles; as it is reflected from the capsule to the femur, it clothes the anterior and lateral surfaces of the femoral condyles for half an inch beyond their articular surface. It is reflected around the ligaments and tendons within the joint, viz. the crucial ligaments, semilunar cartilages, and the tendon of the popliteus. It may communicate with the sub-crureal and sub-semimembranosus bursæ.

LIGAMENTUM MUCOSUM (fig. 98).—The synovial membrane covers the sub-patellar pad of fat, and from there a strand of it (ligamentum mucosum) passes across the joint to the inter-condylar notch.

ALAR LIGAMENTS.—A fold of synovial membrane will be seen to pass on each side of the patella, making a synovial fossa in which that bone is situate. These are the alar folds or ligaments; they commence below on the sub-patellar pad of fat.

Villi occur on the synovial membrane, especially in the recesses near the patella. They secrete synovial fluid and become enlarged in disease.

VIII. Articular Surfaces of the Bones.—Three articular surfaces are to be distinguished on the femur: (1) Trochlear; (2) Internal condylar; (3) External condylar.

Three corresponding articular surfaces are to be distinguished below: (1) Patellar; (2) Internal tibial; (3) External tibial.

During a movement from complete extension to complete flexion the three femoral surfaces move against the three corresponding lower surfaces.

Movements.—(1) BETWEEN THE PATELLA AND TROCHLEAR SURFACE.—Seven facets will be observed on the articular surface of the patella, viz. two upper, two middle, two lower, and an internal marginal. In complete extension, only the two lower facets are in contact with the trochlear surface of the femur; as the joint is flexed, the middle and then the upper facets come in contact with it, and lastly, in complete flexion, the patella comes to rest on the margins of the condylar notch in front. The inner marginal facet of the patella is then in contact with the prolongation of the trochlear surface on the outer margin of the internal condyle.

(2) BETWEEN THE ARTICULAR SURFACES OF THE CONDYLES OF THE FEMUR AND TUBEROSITIES OF THE TIBIA.—In complete extension, the lower surfaces of the femoral condyles rest on the articular surfaces of the tibia and semilunar cartilages, the anterior margins of the cartilages being wedged in the grooves which separate the trochlear or patellar from the two condylar surfaces. The posterior extremities of the condyles are directed towards the popliteal space and are in contact with the posterior capsule of the joint. All the ligaments are tense, lateral or rotatory movements being then impossible.

During a movement from complete extension to complete flexion, the condylar surfaces roll and glide on the tibial surfaces until at the end of the movement only the posterior ends of the condyles are in contact with the tibia. All the ligaments, with the exception of the posterior crucial, are then lax; lateral and rotatory movements are then possible.

It will be observed that the internal condyle is longer than the external, and that it is curved outwards at its anterior end as it joins the trochlear surface. It will be evident that, in passing from complete flexion to complete extension, the external condyle, owing to its being shorter, will have completed its movement before the internal. The completion of movement by the internal condyle leads to an inward rotation of the femur at the end of extension of the joint. This movement 'locks'

the joint ; it cannot be opened until the femur rotates outwards again, and thus initiates the movement of extension.

It will thus be seen that the movements at the knee-joint are (1) flexion, (2) extension, (3) rotation, (4) lateral movement. The last two movements are possible only during positions of flexion.

The femur should now be detached.

DISSECTION XIII

THE SOLE OF THE FOOT

The foot is fixed to the block in the manner described for dissection of the back of the leg (p. 220). The skin is thick and closely bound by dense subcutaneous tissue to the underlying plantar fascia.

REFLECTION OF THE SKIN.—Before reflecting the skin the student should take an opportunity of examining any corns or bunions which may be present. One is likely to be found over the 'ball' of the great toe. He should make a section right through it, down to the subcutaneous tissue. He will observe the great localised thickenings of the epithelial layers of the skin.

Having made a median longitudinal incision along the sole and a transverse incision near the toes, the skin should be reflected from the sole of the foot. Notice that the skin under the heel near its outer border, and under the heads of the metatarsal bones, is much thickened. An area of thin skin is found on the inner side of the arch of the foot. The skin must be removed from the toes, and the sheaths for the flexor tendons exposed (Plate XXXIV).

SUPERFICIAL FASCIA.—The superficial fascia under the thickened portions of skin is very deep, tough, and subdivided by fibrous septa into a number of coarse lobules. Near the toes a transverse arrangement of fibres forms the *superficial transverse ligament*.

SUPERFICIAL VESSELS AND NERVES (Plate XXXIV).—Branches are supplied to the skin by the *internal* and *external plantar* vessels and nerves, and posteriorly by the *internal calcanean* branches of the posterior tibial vessels and nerves.

PLATE XXXIV.

SUPERFICIAL STRUCTURES OF THE SOLE OF THE FOOT.

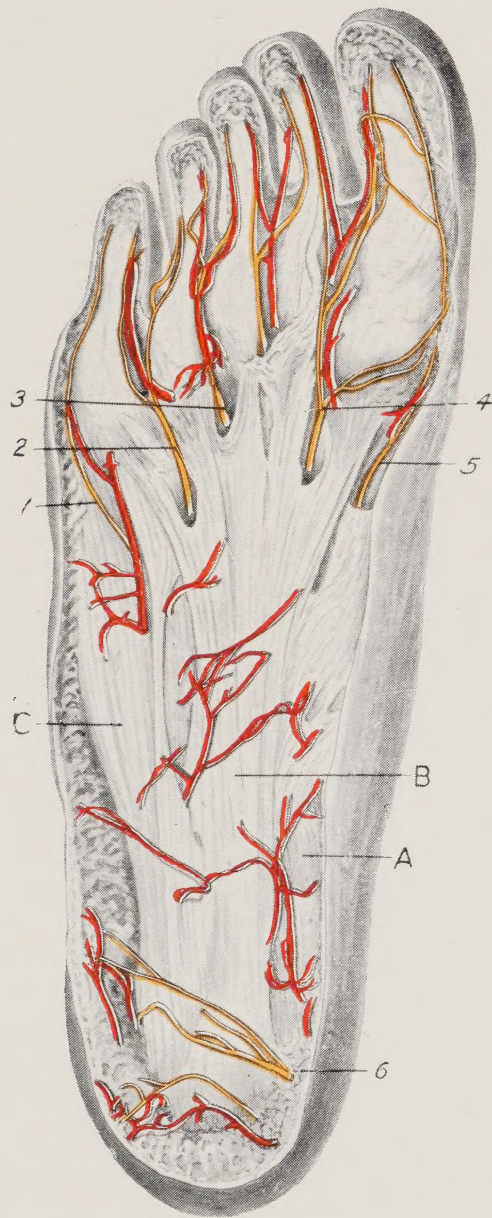
Plantar Fascia.

- A. Internal part.
- B. Middle part.
- C. External part.

Nerves.

- 1, 2. Digital branches of external plantar.
- 3, 4, 5. Digital branches of internal plantar.
- 6. Internal calcanean of posterior tibial.

PLATE XXXIV.



These vessels and nerves, with the subcutaneous tissue, are now to be cleared away and the deep plantar fascia exposed.

Plantar Fascia (Plate XXXIV).—This consists of a central and two lateral portions; between the three portions, intermuscular septa dip into the sole of the foot (fig. 102). The *internal lateral portion* is a thin layer which covers the abductor hallucis muscle. The *external lateral portion* covers the abductor minimi digiti and forms a thick band, which extends from the outer tuberosity of the os calcis to the base of the fifth metatarsal bone.

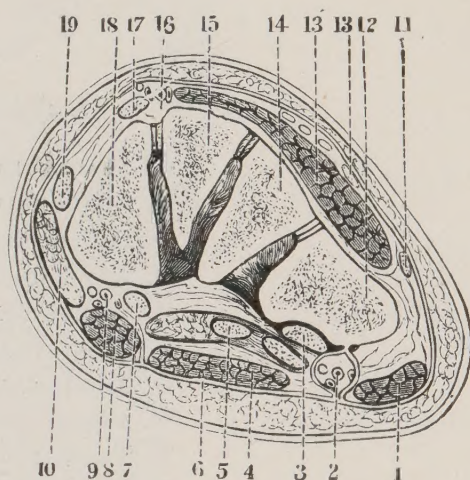
The *central portion* is very thick, and is attached posteriorly by a narrow extremity to the anterior margin of the internal tuberosity of the os calcis. Anteriorly it spreads out and divides near the toe into five slips, which correspond, except in number, with the four slips of the palmar fascia. Each slip joins the sheath of the flexor tendons on the toes and the metatarsophalangeal ligaments as in the hand. The digital slips, like those of the palmar fascia, are united together by transverse fibres which pass over the digital vessels and nerves (Plate XXXIV).

The deep surface of the central portion gives extensive origin to the flexor brevis digitorum, and at the sides of this muscle strong intermuscular septa dip into the sole of the foot, separating it from the adjoining muscles (fig. 101). The middle part is extremely strong, and assists in maintaining the arch of the foot (fig. 102).

Relative Positions of Structures in the Sole of the Foot.—The muscles and tendons are arranged in four layers (Plates XXXIV, XXXV, XXXVI, and fig. 102).

THE FIRST LAYER.—Immediately underneath the plantar

FIG. 102. SECTION SHOWING THE TRANSVERSE ARCH OF THE FOOT AND THE STRUCTURES IN THE SOLE. (After Henle.)



1. Abductor minimi digiti. 2. External plantar vessels and nerve. 3. Tendon of peroneus longus. 4. Flexor brevis digitorum. 5. Flexor longus digitorum. 6. Plantar fascia. 7. Flexor longus hallucis. 8, 10. Abductor hallucis. 9. Internal plantar vessels and nerve. 11. Peroneus tertius. 12. Cuboid. 13. Dorsal aponeurosis. 13'. Extensor brevis digitorum. 14. External cuneiform. 15. Middle cuneiform. 16. Dorsalis pedis vessels and nerve. 17. Extensor longus hallucis. 18. Internal cuneiform. 19. Tibialis anticus.

PLATE XXXV.

STRUCTURES OF THE SOLE BENEATH THE FIRST LAYER OF MUSCLES.

Muscles and Tendons.

- A. Flexor brevis digitorum.
- B. Abductor minimi digiti.
- C. Part of flexor brevis digitorum.
- D. Abductor hallucis.
- E. Flexor accessorius.
- F. Plantar fascia.
- G. Tendons of flexor brevis digitorum.
- H. Flexor brevis hallucis.
- I. Tendon of flexor longus digitorum.
- J. Tendon of flexor longus hallucis.

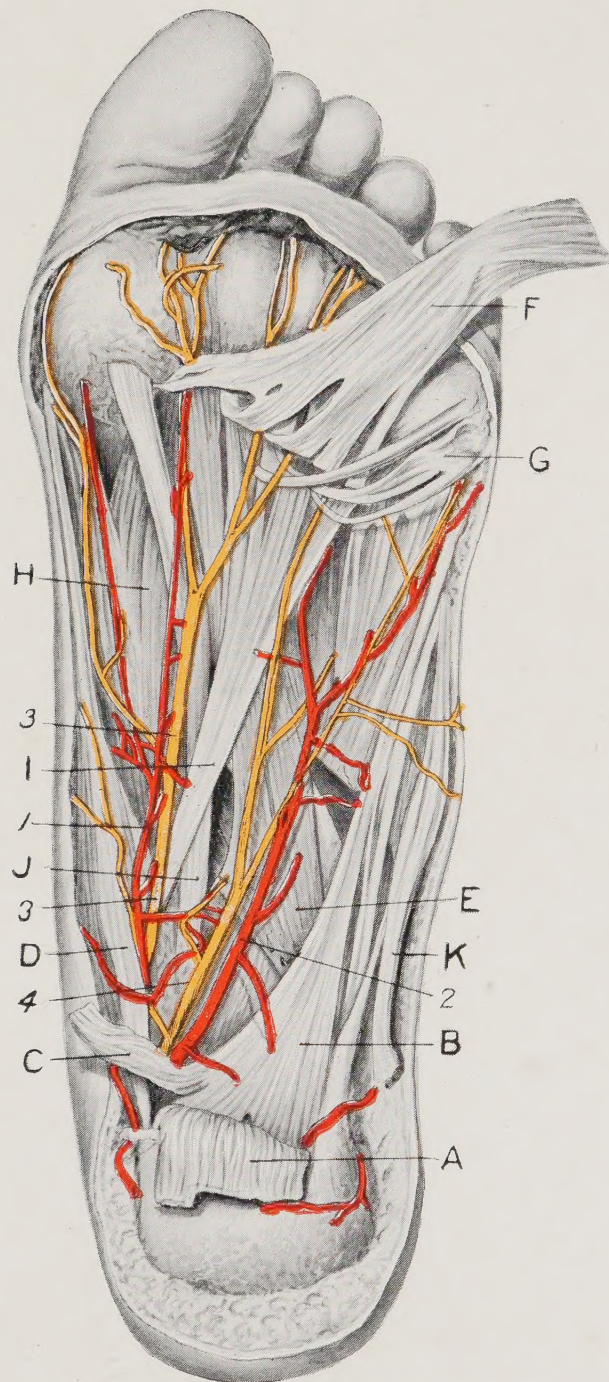
Arteries.

- 1. Internal plantar.
- 2. External plantar.

Nerves.

- 3. Internal plantar.
- 4. External plantar.

PLATE XXXV.



fascia is the first layer, formed by (*a*) the abductor hallucis ; (*b*) the flexor brevis digitorum ; (*c*) the abductor minimi digiti.

THE SECOND LAYER.—Beneath these is a layer of tendons and muscles, viz. (*a*) the flexor longus digitorum ; (*b*) the flexor longus hallucis ; (*c*) the accessorius ; (*d*) the lumbrical muscles.

THE THIRD LAYER is entirely muscular and formed by (*a*) the flexor brevis hallucis ; (*b*) the adductor obliquus hallucis ; (*c*) the adductor transversus hallucis ; (*d*) the flexor brevis minimi digiti.

THE FOURTH OR DEEPEST LAYER, partly tendinous and partly muscular, is closely applied to the tarsal and metatarsal bones, and consists of (*a*) the interosseous muscles ; (*b*) the tendon of the tibialis posticus ; (*c*) the tendon of the peroneus longus.

The plantar vessels and nerves lie at their commencement beneath the first layer, then they appear superficially in the intervals between the three muscles of that layer. The *external plantar vessels* and nerve (Plate XXXVI) in their terminal part take a deep position under the adductor obliquus hallucis.

For convenience of description and revision the first three layers will be described before the blood-vessels, but it must be borne in mind that during the dissection of these layers the plantar vessels and nerves are met with and must be carefully preserved.

The description of the fourth layer is conveniently postponed until the vessels and nerves have been described and examined.

The First Layer of Muscles :

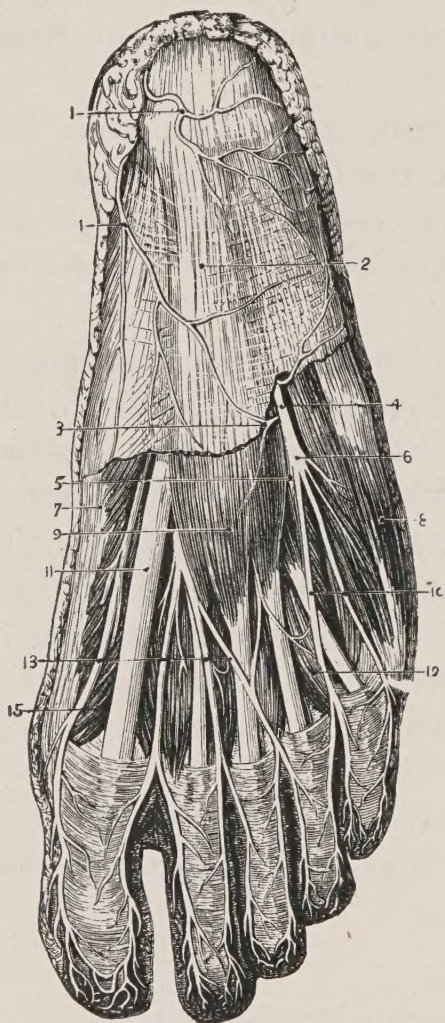
- (1) Abductor hallucis. (2) Flexor brevis digitorum.
- (3) Abductor minimi digiti.

The plantar fascia will be found difficult to remove, especially in the tarsal half of the foot, where the flexor brevis digitorum arises from its deep surface. It is cut away and the first layer of muscles cleaned. The septa at each side of the flexor brevis are noted. The internal annular ligaments should be cut away when the abductor hallucis has been examined.

Abductor Hallucis (Plate XXXVI).—ORIGIN. From the inner tuberosity of the os calcis, from the plantar fascia, and from the lower border of the internal annular ligament.

INSERTION.—By a strong tendon to the inner side of the base of the first phalanx of the great toe. This is joined by the inner head of the flexor brevis hallucis. A sesamoid occurs in the glenoid ligament near their insertion.

FIG. 103.—SUPERFICIAL NERVES OF THE SOLE OF THE FOOT. (*Hirschfeld and Leveillé.*)



- 1, 1. Cutaneous plantar branches of posterior tibial nerve. 2. Plantar fascia. 3. Cutaneous branch of external plantar nerve. 4. External plantar nerve. 5. Its deep division. 6. Its superficial division. 7. Abductor hallucis. 8. Abductor minimi digiti. 9. Flexor brevis digitorum. 10. Digital branches of external plantar nerve. 11. Tendon of flexor longus hallucis. 12. One of the lumbricales muscles. 13. Digital branches of internal plantar nerve. 15. Flexor brevis hallucis.

ACTION.—It flexes the proximal and middle phalanges, and helps to maintain the arch of the foot.

Abductor Minimi Digiti.—**ORIGIN.** By a broad attachment to the outer and inner tuberosities of the os calcis, and from the plantar fascia.

NERVE SUPPLY.—From the internal plantar nerve.

ACTION.—It is mainly a flexor of the great toe; its power of abduction is slight; it helps to maintain the arch of the foot.

Flexor Brevis Digitorum (fig. 103).—**ORIGIN.** From the internal tuberosity of the os calcis and from the plantar fascia and intermuscular septa.

INSERTION.—By four tendons into the four outer toes. Each tendon enters a fibrous sheath like those on the fingers, and divides into two slips which enclose the tendon of the long flexor. The two slips unite partly underneath the tendon of the flexor longus to separate again and form two distinct bundles, which are inserted one on each side of the shaft of the second phalanx of the corresponding toe. It will be thus seen that the insertion resembles that of the flexor sublimis digitorum in the hand (fig. 42, p. 99). The muscle for the little toe is often fibrous or absent.

NERVE SUPPLY.—From the internal plantar nerve.

INSERTION.—Into the outer side of the base of the proximal phalanx of the little toe.

NERVE SUPPLY.—From the external plantar.

ACTION.—Mainly a flexor of the small toe; the power of abduction is slight.

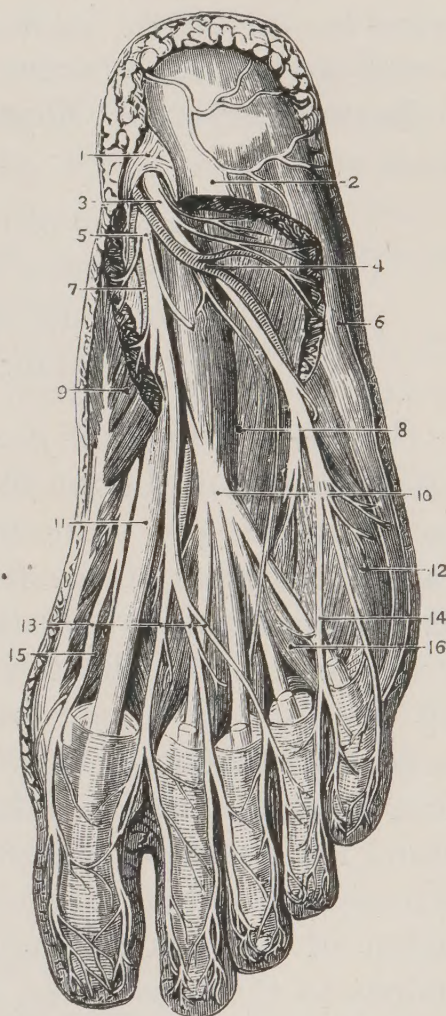
Internal Plantar Nerve (figs. 103, 104, and 105).—The posterior tibial nerve was seen to divide into internal and external plantar nerves beneath the internal annular ligament. Now that the internal annular ligament has been removed, the origin of the plantar nerves and the distribution of the internal calcanean branch of the posterior tibial can be conveniently traced.

The internal plantar nerve passes forwards beneath the origin of the abductor hallucis and then between the abductor and flexor brevis digitorum, in company with the internal plantar artery, which is of small size.

The nerve becomes superficial some distance behind the cleft between the first and second toes. It divides into the following terminal *digital* branches (fig. 103): (1) to the inner side of the great toe; (2) to the adjacent sides of the first and second toes; (3) to the adjacent sides of the second and third toes; (4) to the adjacent sides of the third and fourth toes. The distribution in manner and extent agrees with the distribution of the median in the hand.

In its course forwards the nerve supplies (1) cutaneous

FIG. 104.—THE PLANTAR NERVES.
(Hirschfeld and Leveillé.)



1. Internal annular ligament. 2. Flexor brevis digitorum (cut). 3. External plantar nerve. 4. External plantar artery. 5. Internal plantar nerve. 6. Abductor minimi digiti. 7. Internal plantar artery. 8. Accessorius muscle. 9. Abductor hallucis. 10. Flexor longus digitorum. 11. Flexor longus hallucis. 12. Flexor brevis minimi digiti. 13. Digital branches of internal plantar nerve. 14. Digital branches of external plantar nerve. 15. Flexor brevis hallucis. 16. One of the lumbricales.

branches to the skin of the inner aspect of the sole of the foot ; (2) muscular branches to the abductor hallucis, flexor brevis digitorum, flexor brevis hallucis, and innermost lumbrical.

When the nerve has been traced to the toes, the *plantar vessels* and *external plantar nerve* (Plate XXXV), which are now partly exposed, should be traced, and, by detaching the origins of the first layer of muscles and throwing them forwards, a further view of the vessels and nerve and the second layer of muscles can be obtained.

Second Layer of Muscles and Tendons (Plate XXXV). These are :

- (1) The tendon of the flexor longus hallucis.
- (2) The tendons of the flexor longus digitorum.
- (3) The flexor accessorius.
- (4) The four lumbrical muscles.

(1) The tendon of the *flexor longus hallucis* (fig. 104) can now be followed from the muscle on the back of the fibula, beneath the astragalus and sustentaculum tali, until it crosses underneath the tendon of the flexor longus digitorum to reach the base of the terminal phalanx of the great toe. It is joined to the tendons of the flexor longus digitorum by a tendinous slip.

(2) The tendon of the *flexor longus digitorum* crosses the lower insertion of the internal lateral ligament of the ankle behind the tendon of the tibialis posticus (Plate XXXIII). It becomes somewhat expanded as it crosses superficial to the tendon of the flexor longus hallucis, and divides into four tendons to the four outer toes. Each tendon passes through the divided tendon of the flexor brevis digitorum and is inserted into the base of the terminal phalanx (fig. 42, p. 99). Within the vaginal ligament of the toes the tendons of the long and short flexors lie in a synovial sheath. Short and long synovial vincula bind the tendons to the plantar surface of the phalanges. The vaginal ligament is to be laid open and these vincula examined.

(3) **Flexor Accessorius** (fig. 104).—ORIGIN. By a large fleshy *inner head* from the concave inner surface of the os calcis above the inner tuberosity, and by a narrow tendinous *outer head* from the under surface of the os calcis in front of the outer tubercle (Plate XXXVIII).

INSERTION.—By a fleshy mass into the outer border and deep surface of the expanded portion of the flexor longus digitorum.

NERVE SUPPLY.—From the external plantar.

ACTION.—It flexes the toes and also corrects the inward tendency in the action of the flexor longus digitorum.

(4) The **Lumbrical Muscles** are four in number (Plate XXXV). They arise from the tendons of the flexor longus digitorum, and wind round in the clefts on the tibial side of the four outer toes to be inserted into the expansions of the extensor tendons as in the fingers (fig. 48, p. 118). The innermost muscle arises from the tibial side of the long flexor tendon to the second toe. The outer three arise from the adjacent borders of the tendons between which they lie.

NERVE SUPPLY.—The outer three are supplied from the external plantar; the innermost from the internal plantar nerve.

ACTION.—They flex the proximal phalanges and extend the two distal phalanges.

The layer of muscles and tendons just examined has now to be removed. The origin of the flexor accessorius is left; the tendons are cut as they enter the vaginal sheaths on the toes; they are also cut at the inner side of the ankle. The plantar vessels and nerves, which have already been cleaned and defined, are left intact and in place (Plate XXXVI).

Third Layer of Muscles (fig. 106) :

- (1) Flexor brevis hallucis.
- (2) Adductor obliquus hallucis.
- (3) Adductor transversus hallucis.
- (4) Flexor brevis minimi digiti.

(1) **Flexor Brevis Hallucis**.—ORIGIN. By a narrow tendon from the cuboid, plantar ligaments, and from the tendon of the tibialis posticus. It divides into two bellies, one on each side of the tendon of the flexor longus hallucis.

INSERTION.—By two tendons to the base of the proximal phalanx of the great toe. Two sesamoids are imbedded in the glenoid ligament of the metatarso-phalangeal articulation near the insertions of the tendons.

NERVE SUPPLY.—From the internal plantar nerve.

ACTION.—It flexes the proximal phalanx of the great toe.

PLATE XXXVI.

STRUCTURES OF THE SOLE BENEATH THE SECOND LAYER OF MUSCLES.

Muscles.

- A. Flexor brevis digitorum.
- B. Flexor longus digitorum.
- C. Plantar interosseus.
- D. Adductor obliquus hallucis.
- E. Flexor accessorius.
- F. Abductor minimi digiti.
- G. Flexor brevis digitorum.
- H. Abductor hallucis.
- I. Flexor brevis hallucis (inner head).
- J. Flexor longus hallucis.
- K. Tendon of flexor longus digitorum.

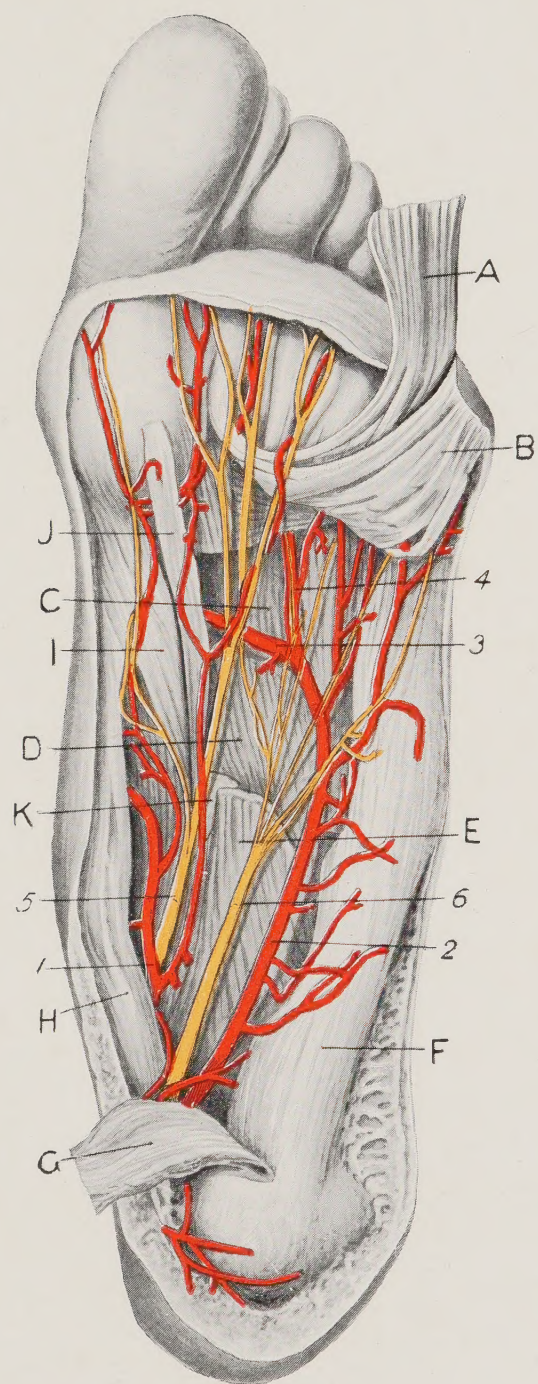
Arteries.

- 1. Internal plantar.
- 2. External plantar.
- 3. Deep plantar arch.
- 4. Plantar interosseus.

Nerves.

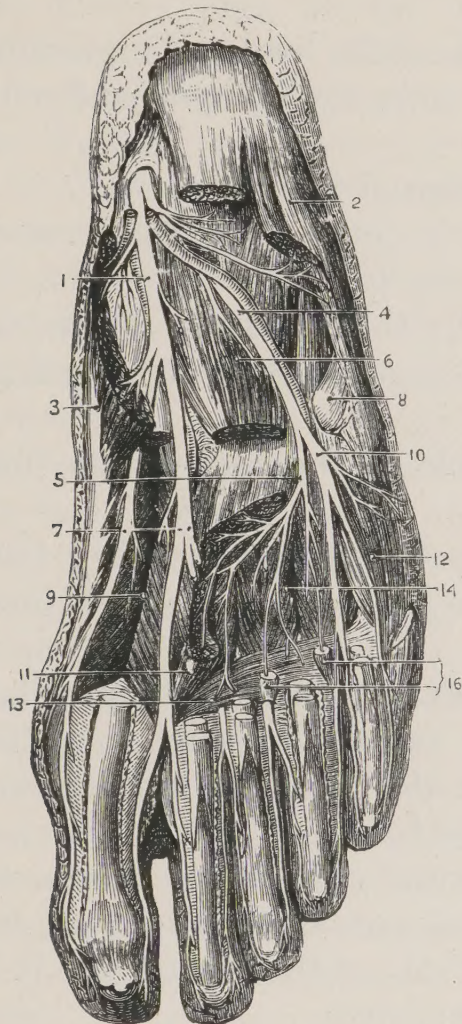
- 5. Internal plantar.
- 6. External plantar.

PLATE XXXVI.



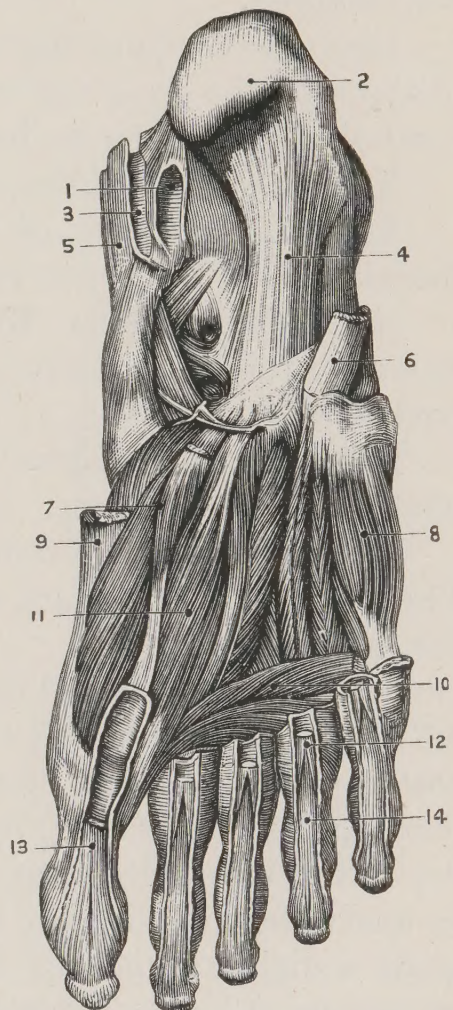
(2) **Adductor Obliquus Hallucis.**—**ORIGIN.** From the bases of the second, third, and fourth metatarsal bones and from the sheath of the peroneus longus.

FIG. 105.—TERMINATION OF EXTERNAL PLANTAR NERVE. (*Hirschfeld and Leveillé.*)



1. Internal plantar nerve. 2. Abductor minimi digiti. 3. Abductor hallucis. 4. External plantar nerve. 5. Its deep division. 6. Accessorius muscle. 7. Digital branches of internal plantar nerve. 8. Tendon of peroneus longus. 9. Flexor brevis hallucis. 10. Superficial division of external plantar nerve. 11. Adductor transversus hallucis. 12. Flexor brevis minimi digiti. 13. Adductor obliquus hallucis. 14. Interosseous muscles. 16. Two outer lumbricales.

FIG. 106.—THIRD LAYER OF MUSCLES OF THE SOLE OF THE FOOT. (*Sappey.*)



1. Sheath of flexor longus hallucis. 2. Os calcis. 3. Sheath of flexor longus digitorum. 4. Long plantar ligament. 5. Sheath of tibialis posticus. 6. Tendon of peroneus longus. 7. Flexor brevis hallucis. 8. Flexor brevis minimi digiti. 9. Tendon of abductor hallucis. 10. Transversus pedis. 11. Adductor hallucis. 12. Tendon of flexor brevis digitorum to fourth toe. 13. Tendon of flexor longus hallucis. 14. Tendon of flexor longus digitorum to fourth toe.

INSERTION.—Into the outer side of the base of the proximal phalanx of the great toe with the outer head of the flexor brevis hallucis.

NERVE SUPPLY.—From the deep division of the external plantar nerve.

ACTION.—It adducts the great toe.

Under the muscle pass the external plantar vessels and nerve (Plate XXXVI).

(3) **Adductor Transversus Hallucis.**—**ORIGIN.** From the under surfaces of the outer three metatarso-phalangeal joints. It is commonly semi-fibrous ; its fasciculi are scattered and not well marked.

INSERTION.—Into the outer side of the base of the proximal phalanx of the great toe with the adductor obliquus and outer head of the flexor brevis hallucis.

NERVE SUPPLY.—From the external plantar nerve.

ACTION.—The use of narrow boots renders this muscle functionless. Hence its vestigial condition.

(4) **Flexor Brevis Minimi Digiti.**—**ORIGIN.** From the groove of the under surface of the base of the fifth metatarsal bone.

INSERTION.—Into the outer side of the base of the first phalanx of the little toe.

NERVE SUPPLY.—From the external plantar nerve (fig. 105). The muscle lies in contact with, and is hard to distinguish from, the interossei.

Plantar Vessels.—The **Internal Plantar Artery** (Plate XXXV), the smaller of the two terminal branches of the posterior tibial, lies at first under the abductor hallucis, and then passes forwards in the interval between that muscle and the flexor brevis digitorum. Near the great toe it terminates by anastomosing with the innermost plantar digital artery, and sends a digital branch to the inner side of the great toe. It is accompanied by the internal plantar nerve.

BRANCHES.—(1) In its course forwards it gives off *cutaneous and muscular branches* to the skin of the sole and adjacent muscles (Plate XXXIV).

(2) Near its termination it frequently supplies *superficial digital branches* to the clefts of the three or four inner toes.

External Plantar Artery (Plate XXXVI).—**COMMENCEMENT.** The external plantar artery is much larger than the internal, and commences at a point midway between the os calcis and inner malleolus, under the origin of the abductor hallucis and the internal annular ligament.

FIRST STAGE.—From this point it extends obliquely across the sole of the foot to the base of the fifth metatarsal bone

lying beneath the flexor brevis digitorum and on the flexor longus digitorum and flexor accessorius.

SECOND STAGE.—At the base of the fifth metatarsal bone, it bends sharply inwards and, becoming much deeper, it passes across the sole under the adductor obliquus hallucis, towards the hinder part of the first interosseous space. There it is joined by the termination of the dorsalis pedis artery (Plate XXV). This stage of the artery forms the *plantar arch*. The adductor obliquus must be removed to examine it.

RELATIONSHIPS.—The *first stage* of the artery lies between the flexor brevis digitorum and the flexor accessorius, and afterwards between the flexor brevis digitorum and the abductor minimi digiti.

The *second stage* or *plantar arch* lies upon the bases of the metatarsal bones and interosseous muscles, and underneath the adductor obliquus hallucis and the muscles and tendons of the first and second layers. The artery is accompanied in its entire extent by the external plantar nerve and by *venæ comites*.

BRANCHES (fig. 107).—From the *first stage*:

(a) *Calcanean* branch to the integument of the heel. It perforates the annular ligament.

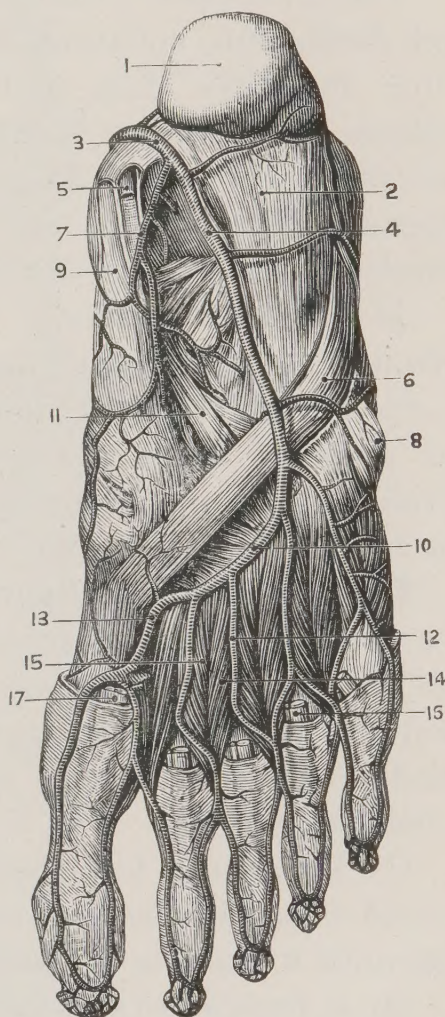
(b) *Cutaneous* branches to the skin of the sole.

(c) *Muscular* branches to the adjacent muscles.

From the *second stage* or *plantar arch*:

(a) Three *posterior perforating* branches. They pierce the

FIG. 107.—THE DEEP PLANTAR ARCH.
(Bonamy and Beau.)



1. Os calcis. 2. Ligamentum longum plantæ.
3. Posterior tibial artery. 4. External plantar artery. 5. Tendon of flexor longus hallucis.
6. Tendon of peroneus longus. 7. Internal plantar artery. 8. Base of fifth metatarsal bone.
9. Tendon of tibialis posticus. 10. Plantar arch. 11. Prolongation of tendon of tibialis posticus.
12. Digital artery. 13. Communicating branch of dorsal artery of foot.
14. Plantar interosseous of second space. 15. Dorsal interosseous of second space.
16. Tendon of flexor longus digitorum. 17. Tendon of flexor longus hallucis.

posterior ends of the three outer interosseous spaces and join the dorsal interosseous arteries.

(b) *Articular* branches to the joints of the foot.

(c) *Four digital or interosseous arteries* (fig. 107). The outer branch is undivided and passes to the outer side of the little toe.

The *three inner branches* pass to the three outer interspaces and divide into collateral digital branches for the toes. These three branches pass underneath the adductor transversus hallucis. Near their points of division they are connected by *anterior perforating* branches with the dorsal interosseous arteries. The course of the digital arteries on the toes is closely similar to that of the digital arteries in the fingers.

The *arteria princeps hallucis* (fig. 107) or *perforating* terminal part of the dorsalis pedis artery (p. 216) passes forwards to the first interspace, where it divides into digital branches to the adjacent sides of the great and second toes. Before it divides into these branches it may supply a digital branch to the inner side of the great toe.

External Plantar Nerve (fig. 105).—The external plantar nerve arises from the posterior tibial with the internal, which has been already examined, beneath the internal annular ligament. Its distribution resembles that of the ulnar nerve in the hand. Like the external plantar artery which it accompanies, it has two stages :

(1) Across the foot, between the muscles of the first and second layers of the foot, and forwards at the outer side of the foot until it reaches the base of the fifth metatarsal bone.

(2) It passes inwards beneath the adductor obliquus hallucis with the deep plantar arch.

BRANCHES (fig. 105).—From the *first stage* it gives off :

(1) *Cutaneous* branches to the skin of the sole.

(2) *Muscular* branches to the abductor minimi digiti and flexor accessorius.

(3) *Articular* branches to the tarsal bones and joints.

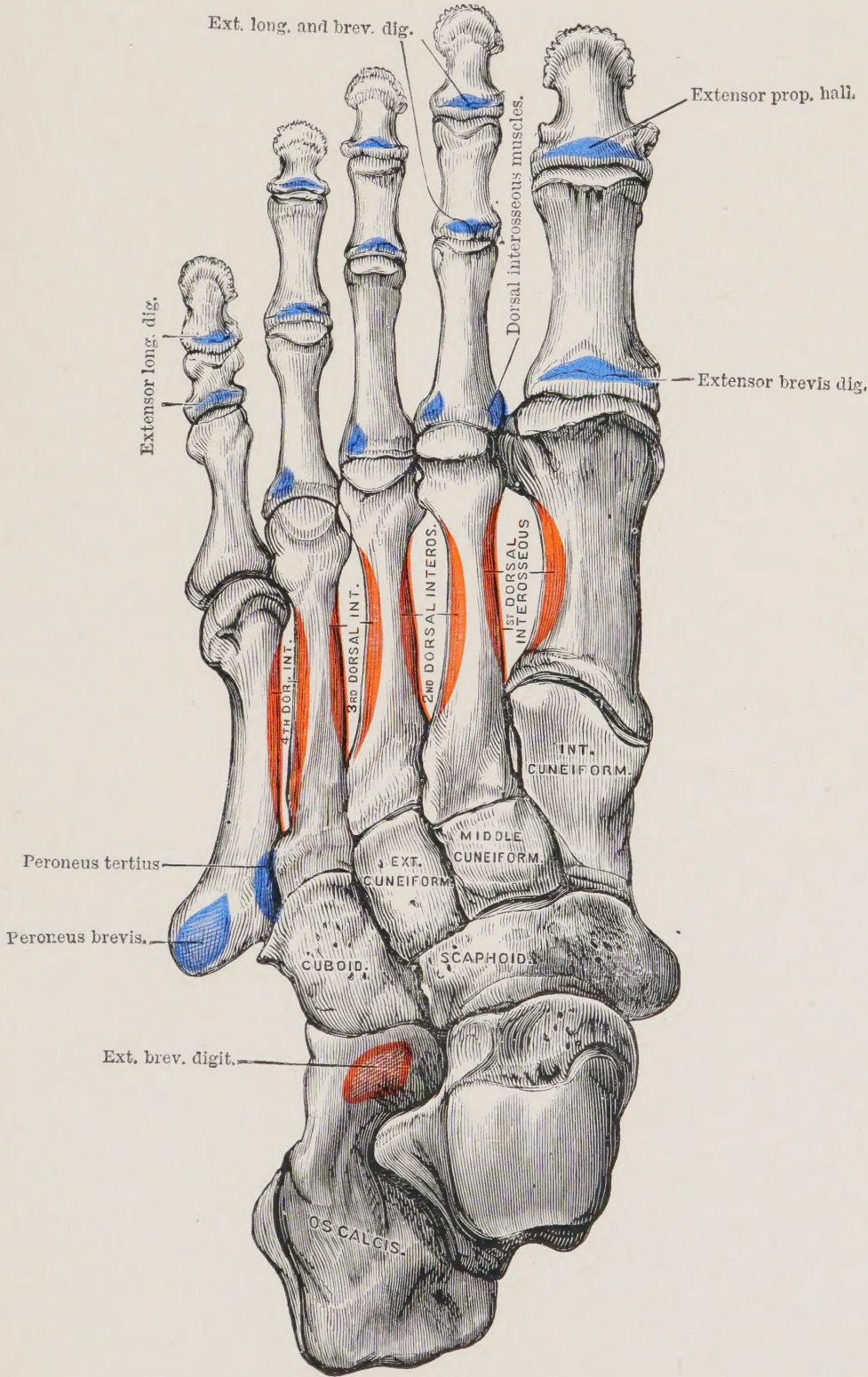
(4) *Two digital* branches, one to the outer side of the little toe, the other to the adjacent sides of the fourth and fifth toes (Plate XXXV). These two branches are sometimes described as the superficial division of the nerve.

From the *second stage* :

(1) *Muscular* branches to all the interosseous muscles, to

PLATE XXXVII.

THE POINTS OF MUSCULAR ATTACHMENT ON THE DORSAL ASPECT OF THE FOOT. (*After Holden.*)



the two adductor muscles of the great toe, and to the three outer lumbrical muscles.

(2) To the joints of the tarsus and metatarsus.

The flexor brevis hallucis should be removed, but its insertion, with the glenoid ligament and the two sesamoid bones, should be left. The adductor obliquus hallucis has already been cut away; the adductor transversus hallucis and the flexor brevis minimi digiti should now be removed in order that the fourth layer of muscles may be displayed. The plantar vessels and nerves should also be cleaned away.

FIG. 108.—THE DORSAL INTEROSSEOUS MUSCLES OF THE FOOT. (Wilson.)

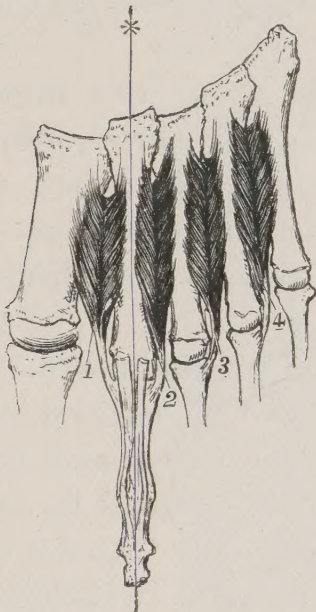


Diagram of the dorsal interosseous muscles of the foot, designed to show that they all *abduct* from the middle line of the second toe.

FIG. 109.—THE PLANTAR INTEROSSEOUS MUSCLES OF THE FOOT. (Wilson.)

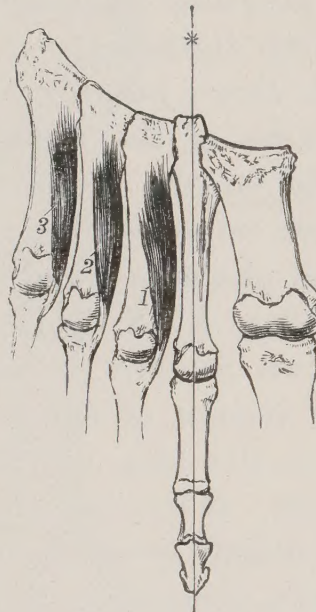


Diagram of the plantar interosseous muscles, designed to show that they are all *adductors* to the middle line of the second toe.

Fourth Layer of Muscles and Tendons (figs. 107, 108, and 109).—(1) Seven interosseous muscles; (2) tendon of peroneus longus; (3) tendon of tibialis posticus.

The Interosseous Muscles.—These are seven in number, four dorsal and three plantar, and are closely similar to those in the hand. They are arranged, however, so as to act towards or away from the second digit in the foot, instead of the third digit as in the hand (figs. 108 and 109).

ACTION AND INSERTION.—Each interosseous muscle has a double insertion, partly to the proximal phalanx and partly to

the extensor tendon. Thus they can act (1) as adductors or abductors of the toes; (2) as flexors of the proximal phalanges; (3) as extensors of the middle and distal phalanges. The three plantar muscles adduct the three outer toes towards the second; the two outer dorsal muscles abduct the third and fourth toes; the two inner act on the second toe.

The *four dorsal interossei* arise from the adjacent sides of the metatarsal bones (Plate XXXVII). They fill the interosseous spaces and may be examined on the dorsal surface of the foot. The first and second muscles are *inserted* to the inner and outer sides of the base of the proximal phalanx and dorsal aponeurosis of the second digit (fig. 48, p. 110). The third and fourth muscles are inserted into the outer sides of the bases of the proximal phalanges and dorsal aponeurosis of the third and fourth digits respectively.

The *three plantar interossei* arise from the inner and under sides of the metatarsal bones of the three outer toes. They lie on the plantar aspect of the three outer spaces. They are *inserted* into the inner sides of the bases of the proximal phalanges and dorsal aponeuroses of the three outer digits (Plate XXXVIII).

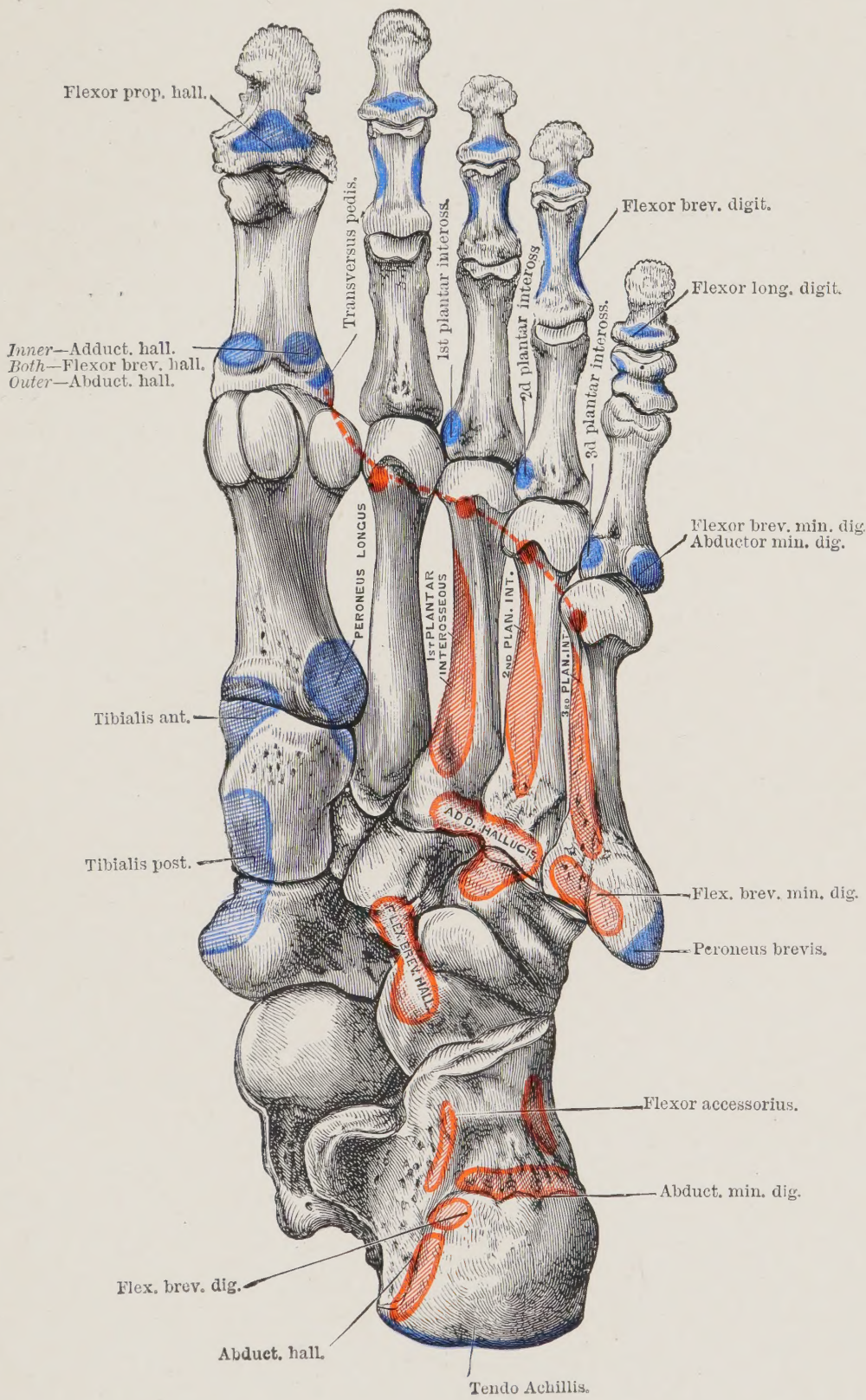
NERVE SUPPLY.—From the external plantar nerve.

The *tendon of the peroneus longus* (fig. 107) should be traced to the base of the first metatarsal bone and internal cuneiform. It lies in a groove on the cuboid, covered by a sheath derived mainly from the long plantar ligament. As the tendon enters the groove on the cuboid, it shows a well-developed sesamoid bone. This glides on a smooth surface on the cuboid behind the groove when the foot is flexed.

The *tendon of the tibialis posticus*, after assisting the internal lateral and inferior calcaneo-scaphoid ligaments to support the arch of the foot, is inserted mainly into the tubercle of the scaphoid. Slips are given off to the sustentaculum tali, cuboid, and cuneiform bones, and to the bases of the second, third and fourth metatarsal bones.

PLATE XXXVIII.

THE POINTS OF MUSCULAR ATTACHMENT ON THE PLANTAR ASPECT OF THE FOOT. (*After Holden.*)



DISSECTION XIV

THE LIGAMENTS AND JOINTS OF THE LEG AND FOOT

When the student has got this far, and it is to be feared that some may not, he must not think that the remaining part scarcely requires his attention. Far from it; he must remember that the ankle-joint, its ligaments, its guarding malleoli, its synovial sheaths and tendons, are amongst the parts of the human body which most frequently require the utmost skill he can bring to bear on them. Again, the mechanism of the arch of the foot, the manner in which it is maintained, are matters of the utmost consequence, for how can he hope to restore the arch when it has collapsed—a not uncommon occurrence—if he does not know how it is normally maintained? Further, the joints of the toes, the manner in which the foot is everted, are matters to him of the utmost practical importance.

All the muscles still remaining on the part must be cleaned away.

Joints and Ligaments between the Tibia and Fibula :

- (1) Superior tibio-fibular joint and ligaments.
- (2) The interosseous membrane.
- (3) Inferior tibio-fibular joint and ligaments.

(1) SUPERIOR TIBIO-FIBULAR JOINT AND LIGAMENTS.—The head of the fibula is bound to the posterior external aspect of the external tuberosity of the tibia by anterior, posterior, and superior short ligaments. The external lateral ligament of the knee-joint binds the head of the fibula to the external condyle of the femur. The tendon of the popliteus lies on the posterior tibio-fibular ligament (fig. 100).

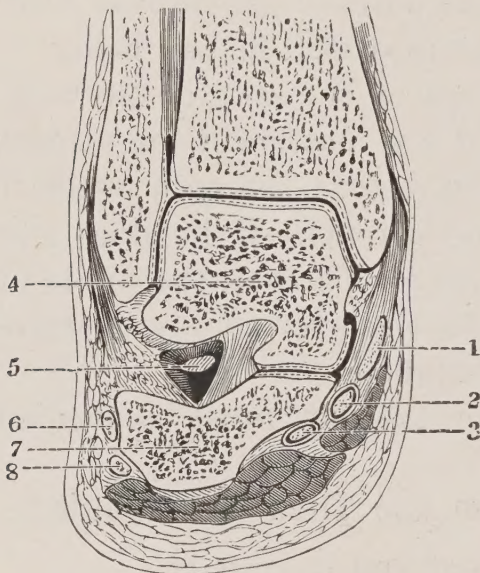
The articular facet is oval and flat. Only a slight degree of a gliding movement is allowed.

(2) THE INTEROSSEOUS MEMBRANE.—This membrane binds the tibia and fibula together, being attached to the interosseous borders of these two bones (Plate XXVI). The fibres are directed downwards and outwards. It does not quite fill the tibio-fibular space; through a hiatus at the upper border appears the anterior tibial artery; at a gap below, the anterior peroneal artery. From its anterior surface arise the tibialis

anticus, the extensor longus digitorum and extensor longus hallucis; the tibialis posticus covers the posterior surface and arises from it.

(3) THE INFERIOR TIBIO-FIBULAR JOINT AND LIGAMENTS (figs. 110 and 111).—The slight articular facet of this joint is lined by a diverticulum from the ankle-joint. The ligaments

FIG. 110.—A VERTICAL SECTION SHOWING THE INFERIOR TIBIO-FIBULAR, ANKLE, AND ASTRAGALO-CALCANEAL JOINTS. (After Henle.)

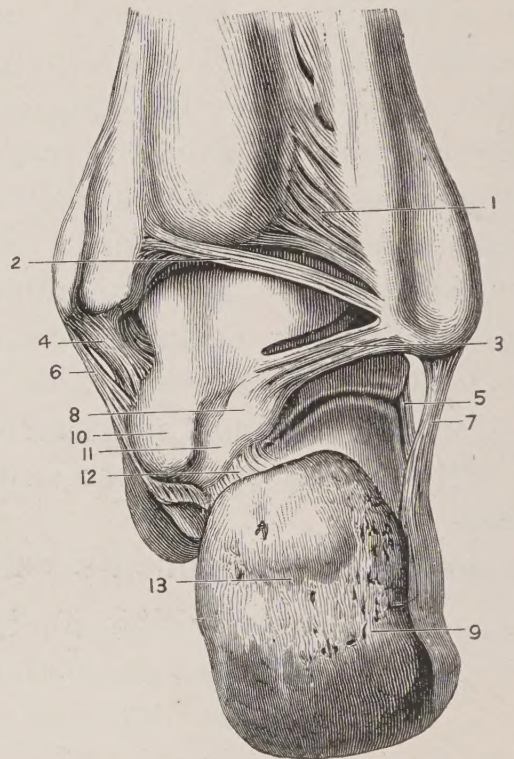


1. Tibialis posticus. 2. Flexor longus digitorum. 3. Flexor longus hallucis. 4. Astragalus. 5. Astragalo-calcaneal ligament. 6. Peroneus brevis. 7. Os calcis. 8. Peroneus longus.

are (a) anterior transverse; (b) posterior transverse; (c) interosseous; (d) inferior transverse, a ligament of great strength and importance. It will be found passing from the rough impression on the inner aspect of the external malleolus to an adjacent impression on the tibia. It runs inwards with, and close to, the posterior fasciculus of the external lateral ligament (fig. 111, 2).

Only a slight degree of movement is allowed at the inferior tibio-fibular joint. The ligaments are very rarely ruptured, although at times subjected to great force from falls on the everted or inverted foot. In such cases it is the fibula which commonly gives way.

FIG. 111.—POSTERIOR VIEW OF THE ANKLE-JOINT. (Sappey.)



1. Posterior inferior tibio-fibular ligament. 2. Transverse ligament. 3. Posterior fasciculus of the external lateral ligament. 4, 6. Internal lateral ligament. 5. External calcaneo-astragalar ligament. 7. Middle fasciculus of external lateral ligament. 8. Tubercle on outer side of groove for flexor longus pollicis. 9. Posterior tuberosity of os calcis. 10. Tubercle on inner side of groove for flexor longus pollicis. 11. Groove on astragalus for flexor longus pollicis. 12. Posterior calcaneo-astragalar ligament. 13. Point of insertion of tendo Achillis.

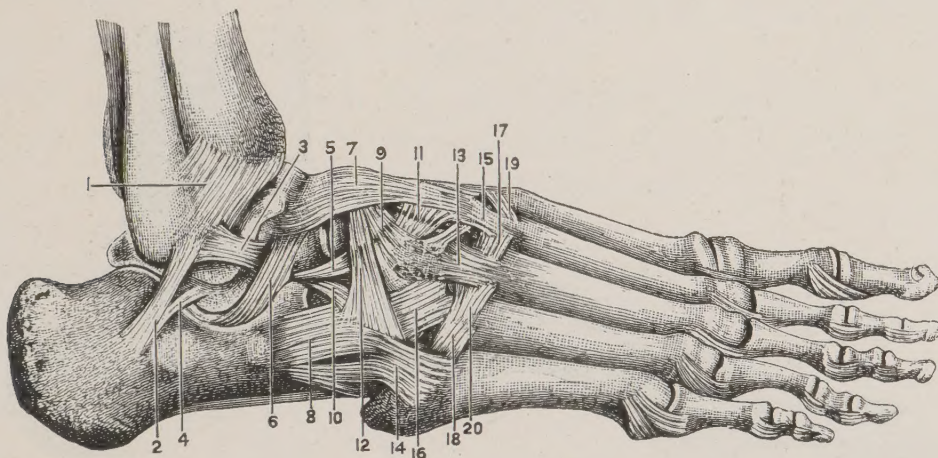
The Ankle-joint.—The points to be noted at this joint are :

- (1) External lateral ligament (figs. 111 and 112).
- (2) Internal lateral or deltoid ligament (fig. 113).
- (3) Anterior and posterior capsular ligaments, filling up the intervals between the lateral ligaments.
- (4) The articular surfaces, synovial membrane, and movements.

External Lateral Ligament.—It consists of three fasciculi :

(a) A *posterior fasciculus* binding the external malleolus to the astragalus. It is attached to the posterior external tubercle

FIG. 112.—LIGAMENTS ON THE OUTER SIDE OF THE ANKLE AND FOOT. (*Sappey.*)



1. Anterior-inferior tibio-fibular ligament. 2. Middle fasciculus of external lateral ligament of ankle. 3. Anterior fasciculus. 4. External calcaneo-astragaloid ligament. 5. External calcaneo-scaphoid ligament. 6. Interosseous calcaneo-astragaloid ligament. 7. Superior astragalo-scaphoid ligament. 8. External calcaneo-cuboid ligament. 9. Superior scapho-cuneiform ligament. 10. Internal calcaneo-cuboid ligament. 11. Dorsal ligament between external and middle cuneiform. 12. Dorsal ligament between scaphoid and cuboid. 13. Dorsal ligament between external cuneiform and third metatarsal. 14. Dorsal ligament between cuboid and fifth metatarsal. 15. Dorsal ligament between middle cuneiform and second metatarsal. 16. Dorsal ligament between cuboid and third and fourth metatarsals. 17, 18, 19, 20. Dorsal ligaments between bases of metatarsal bones.

of the astragalus and to the inner posterior rough impression of the external malleolus (fig. 111, 2).

(b) An *anterior fasciculus* binding the external malleolus and astragalus. It is attached to the neck of the astragalus and anterior border of the malleolus.

(c) A *middle fasciculus* binding the malleolus and os calcis. It passes from the anterior border and tip of the malleolus to a tubercle on the outer surface of the os calcis. The peroneus brevis and longus cross the fasciculus.

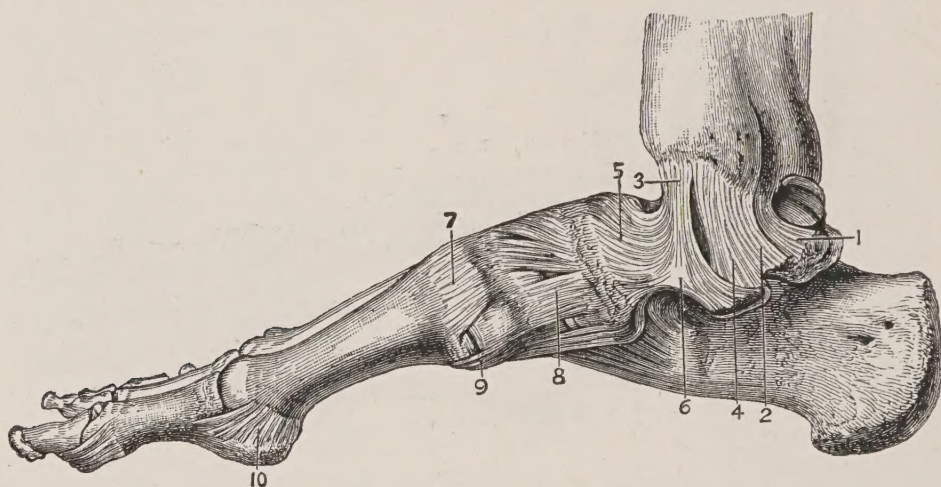
Internal Lateral Ligament.—It is deltoid or triangular in shape, and its anterior part, which is cord-like, of great

strength (fig. 113). Its apex is attached to the tip of the internal malleolus; its base is fixed to the following structures from behind forwards:—(1) the astragalus; (2) sustentaculum tali; (3) inferior calcaneo-scaphoid ligament; (4) scaphoid.

The tendon of the tibialis posticus rests on it. The anterior part assists in maintaining the arch of the foot.

The Anterior and Posterior Caspular Ligaments (fig. 115).—The ankle-joint in front and behind is strengthened by the extensor and flexor tendons; hence the capsule of the joint beneath these is thin and membranous. The anterior and posterior ligaments are attached to the tibia above and the astragalus below, and are loose to allow the movements of

FIG. 113.—LIGAMENTS ON THE INNER SIDE OF THE ANKLE AND FOOT. (*Sappey.*)



1, 2, 3, 4. Different parts of internal lateral ligament of ankle. 5, 6. Inferior calcaneo-scaphoid ligament. 7. Internal ligament between internal cuneiform and first metatarsal. 8. Ligament between the scaphoid and internal cuneiform. 9. Inferior ligament between internal cuneiform and first metatarsal. 10. Inferior ligament of first metatarso-phalangeal joint.

extension and flexion. When fluid collects in the joint, the thin anterior and posterior ligaments become distended; the lateral ligaments are taut, both in flexion and extension, and never yield.

Articular Surfaces, Synovial Membrane, and Movements.—The ankle is chiefly a hinge-joint allowing movements of extension and flexion. When the ankle is flexed the narrow posterior end of the astragalus comes between the malleoli; lateral and rotatory movements are then allowed to some extent. On extension, the broad end of the astragalus is wedged in between the malleoli; the external and internal facets on the astragalus fit against those on the malleoli. The dorsal surface of the neck of the astragalus comes against the

anterior margin of the tibia in complete extension. The *synovial membrane* passes from the margin of the articular cartilage of the tibia and fibula above to the margin of the articular surface of the astragalus below on the interior of the four ligaments which form the capsule of the joint.

The **ligaments of the foot** are so numerous that in a systematic description their relative importance is apt to be lost. It is therefore better to consider them in relationship to their use.

Ligaments which Help to Maintain the Arch of the Foot :

- (1) The inferior calcaneo-scaphoid ligament.
- (2) The long and short plantar ligaments.
- (3) The internal lateral ligament of the ankle-joint, already described.
- (4) Certain inferior tarsal bands on the inner side of the foot. The tendon of the *tibialis posticus* may also be included in this list.

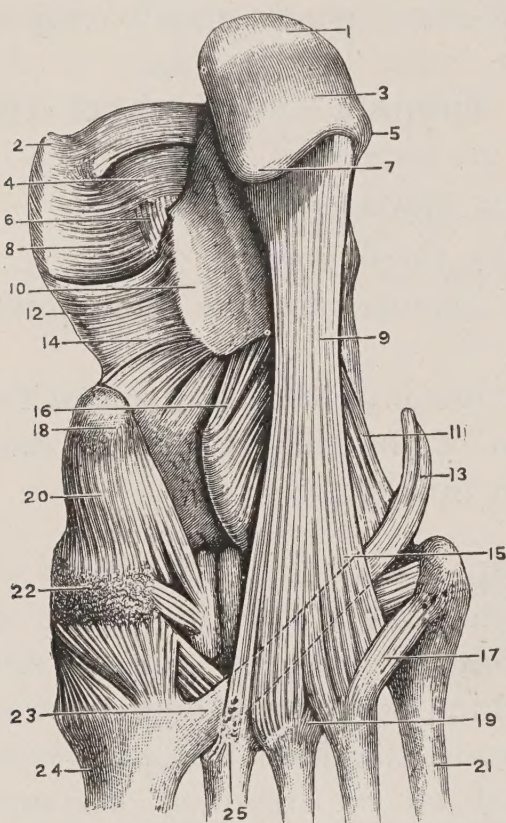
INFERIOR CALCNEO-SCAPHOID LIGAMENT.—The head of the astragalus, the keystone of the arch of the foot, rests on this ligament, which stretches from the sustentaculum tali and inferior border of the os calcis behind to the scaphoid bone in front (figs. 114, 115). It is fibro-cartilaginous in structure. The anterior part of the internal lateral ligament becomes continuous with it. When this ligament stretches, the head of the astragalus falls inwards and forwards, producing the condition known as flat-foot.

THE LONG AND SHORT PLANTAR LIGAMENTS (fig. 114).—The long plantar ligament arises from the lower surface of the os calcis, and ends in front on the sheath of the *peroneus longus* and the bases of the outer metatarsal bones. The deeper fibres (the *short plantar ligament*), rising from the anterior inferior tubercle of the os calcis, end in front on the ridge of the cuboid. They bind the os calcis to the bones of the outer part of the foot.

INTERNAL TARSAL LIGAMENTS.—A band of fibres will be found passing from the scaphoid to the internal cuneiform and continuing forwards the inferior calcaneo-scaphoid ligament. Some of the fibres pass to the base of the metatarsal bone of the great toe.

Other oblique bands of ligamentous fibres join the plantar surfaces of the cuneiform and scaphoid bones, and thus help to maintain the transverse arch of the foot (fig. 102). Amongst these may be counted the *internal interosseous*

FIG. 114.—THE LONG PLANTAR AND OTHER LIGAMENTS OF THE SOLE OF THE FOOT. (Sappey.)



1. Point of attachment of tendo Achillis. 2. Internal malleolus. 3. Posterior tuberosity of os calcis. 4. Posterior part of astragalus. 5. External tubercle on under surface of os calcis. 6. Posterior calcaneo-astragaloid ligament. 7. Internal tubercle of os calcis. 8 and 12. Internal lateral ligament. 9. Long plantar ligament. 10. Groove on sustentaculum tali for flexor proprius hallucis. 11 and 16. Short plantar ligament. 13 and 23. Tendon of peroneus longus. 14. Inferior calcaneo-scapoid ligament. 15 and 25. Sheath of peroneus longus. 17. Plantar ligament between fourth and fifth metatarsals. 18. Tubercle of scaphoid. 19. Plantar ligament between scaphoid and internal cuneiform. 20. Plantar ligament between third and fourth metatarsals. 21. Fifth metatarsal. 22. Internal cuneiform. 24. First metatarsal.

ligament, a structure of some surgical importance (fig. 114). This ligament will be seen beneath the insertion of the tendon of the peroneus longus to the base of the first metatarsal bone. It passes from the inferior aspect of the internal cuneiform to the adjacent surface of the second metatarsal. It has to be divided in disarticulating the foot at the tarso-metatarsal joint. It is reached from the dorsum of the foot by transfixing the posterior end of the first interosseous space, the edge of the knife being directed towards the tarsus.

Inversion and Eversion of the Foot.—Flexion and extension of the foot take place at the ankle-joint; in flexion a slight amount of lateral movement is allowed. The movements of eversion and inversion take place beyond the astragalus.

In the movement of inversion the anterior part of the sole is turned inwards,

the inner border of the foot being raised. In eversion, the outer border of the foot is raised and the sole is directed downwards. These movements take place principally between the astragalus and other tarsal bones, but also slightly between the os calcis and cuboid.

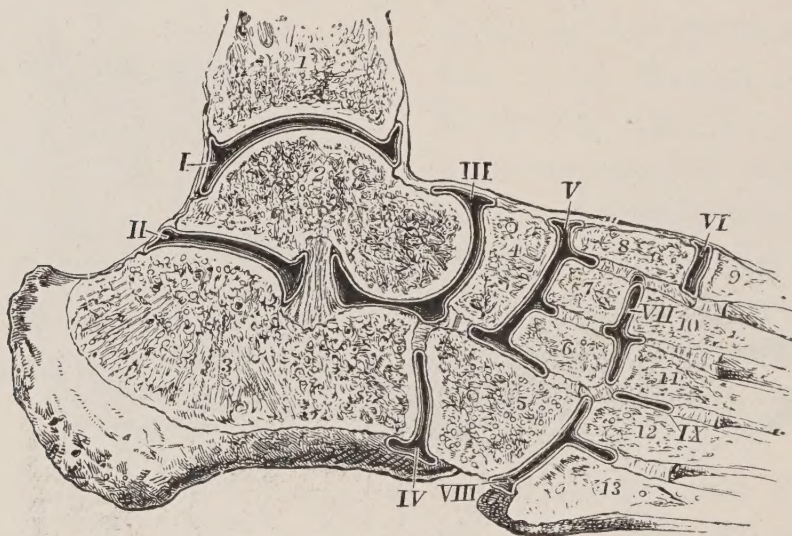
osseous ligament; the external and posterior astragalo-calcanean ligaments strengthen it.

(b) The calcaneo-cuboid. The superior, internal, and inferior calcaneo-cuboid (plantar) ligaments retain the bones in apposition.

The cuboid, scaphoid, cuneiform bones and bases of the metatarsals are joined by dorsal, plantar, and interosseous ligaments.

The *transverse metatarsal ligament* joins the heads of the metatarsal bones together on their plantar aspect. The ligament is attached to the fibrous plates of the metatarso-phalangeal articulations.

FIG. 116.—THE SYNOVIAL MEMBRANES OF THE FOOT. (Allen Thomson.)



1. Tibia. 2. Astragalus. 3. Calcaneum. 4. Scaphoid. 5. Cuboid. 6. External cuneiform.
7. Middle cuneiform. 8. Internal cuneiform. 9. First metatarsal. 10. Second metatarsal.
11. Third metatarsal. 12. Fourth metatarsal. 13. Fifth metatarsal.

Metatarso-phalangeal Joints.—The condylar heads of the metatarsal bones rest on fibrous plates, the glenoid ligaments, which form the plantar part of the capsule of these joints (fig. 115). The plates are firmly attached to the bases of the proximal phalanges, but loosely attached to the heads of the metatarsal bones. The plantar surfaces of the plates are grooved for the flexor tendon and give attachment to the vaginal ligament. The dorsal expansion of the extensor tendons makes up the posterior or dorsal part of the capsule; there are round cord-like *lateral* ligaments.

In the fibrous plate or glenoid ligament of the great toe are imbedded two large sesamoid bones. The head of the metatarsal bone will be found grooved for them. The meta-

tarso-phalangeal joint of the great toe is liable to many troubles; it is a favourite site for the manifestation of gout; it is frequently deformed by tight boots; bunions and corns arise over it.

The *inter-phalangeal joints* are furnished with ligaments similar to those described for the metatarso-phalangeal joints.

SYNOVIAL MEMBRANES OF THE TARSUS.—These are (fig. 116): (1) For the posterior astragalo-calcanean articulation; (2) for the head of the astragalus and its cup; (3) for the calcaneo-cuboid; (4) for the cuboid and fourth and fifth metatarsals; (5) for the internal cuneiform and first metatarsal; (6) for the remaining articulations.

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